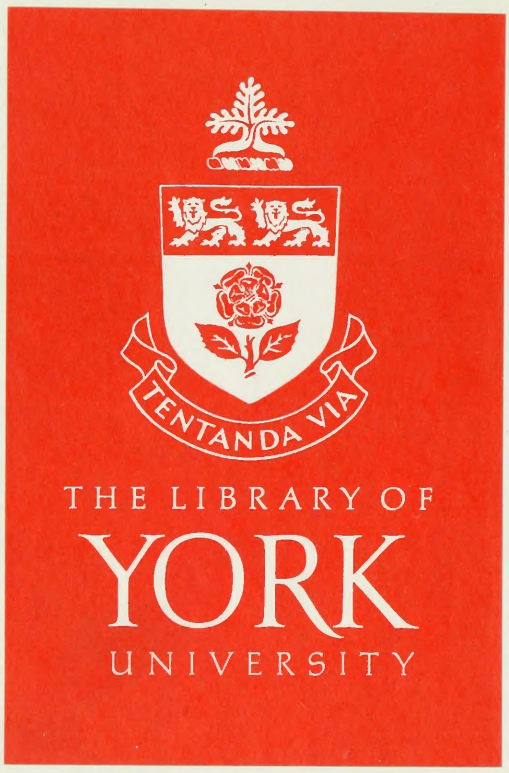

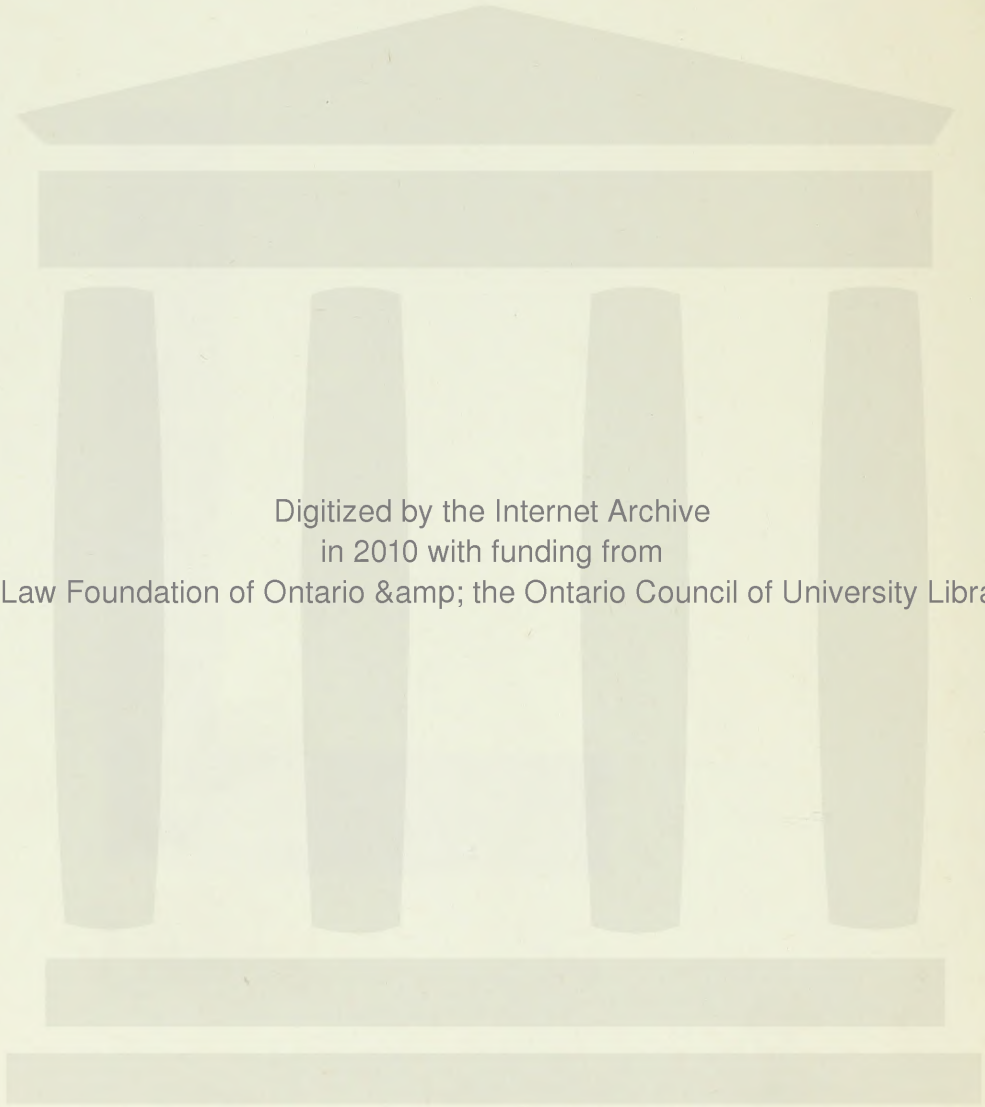

REPORT
OF
THE COMMITTEE APPOINTED TO INQUIRE INTO AND REPORT UPON THE FLUORIDATION OF MUNICIPAL WATER SUPPLIES

1961

ONTARIO

REPORT

of

ontario.

THE COMMITTEE APPOINTED TO INQUIRE INTO AND REPORT UPON THE FLUORIDATION OF MUNICIPAL WATER SUPPLIES

1961

TO His Honour The Lieutenant Governor
of the Province of Ontario.

May It Please Your Honour:

We, the undersigned, appointed by Order-in-Council dated the 17th day of March, 1959, as amended by Order-in-Council dated the 11th day of February, 1960, respectfully submit to Your Honour our report upon the matter referred to us by the said Orders-in-Council.

Dated at Toronto

this 31st day of

January, 1961.

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PART I

INTRODUCTION

1. By Order-in-Council dated March 17th, 1959 as amended by Order-in-Council dated February 11th, 1960, both passed pursuant to The Public Inquiries Act, R.S.O. 1950, chapter 308, we were appointed a Committee to inquire into, examine, and report from time to time upon all matters in any way pertaining to the fluoridation of municipal water supplies. Mrs. Egmont L. Frankel was a member of the Committee until she resigned due to ill-health and Mrs. Cameron McKenzie was appointed to the Committee in her place by the amending Order-in-Council, (Appendix I).

2. Mr. Donald R. Richmond, of the Ontario Department of Economics, was the Committee's Secretary throughout its existence. In January 1960, Mr. Austin M. Cooper, Barrister-at-law, was appointed counsel to the Committee and continued to act in that capacity until this Report was completed.

3. The issue of fluoridation of municipal water supplies can be briefly stated. The hypothesis and contention of the proponents of fluoridation is that the addition of fluoride to water to a recommended concentration will materially reduce the incidence of dental caries without the risk of harm to any organ of the body. Many opponents of fluoridation deny the truth of this hypothesis. Others contend that even if its validity has been established, fluoridation of municipal water supplies is objectionable upon the ground that it is a form of involuntary mass medication and therefore violates the civil rights of citizens to their bodily integrity.

4. Fluoridation of water supplies has been a subject of public controversy in many parts of the world and particularly in this Province since 1955. The Supreme Court of Canada in the case of Metropolitan Toronto vs. Village of Forest Hill (1957) S.C.R 569, decided that Metropolitan Toronto, under the then existing legislation lacked the power to enact a by-law providing for the fluoridation of its water supply. As the legislation in

Ontario now stands, no municipality can fluoridate its water supply. Neither the Supreme Court of Canada nor the Ontario Court of Appeal, whose decision was affirmed, passed upon the merits of fluoridation in either its scientific or civil rights aspects. The only matter in issue was the proper construction of section 41 of The Metropolitan Toronto Act, 1953, and incidentally of section 12 of The Public Utilities Act, R.S.O. 1950, chapter 320, (Appendix II). Mr. Justice Cartwright said in the course of his judgment:

> "... it is fortunate that this is a case in which if we have failed to discern the true intention of the Legislature the matter can be dealt with by an amendment of the statute."

5. Before the judgment of the Supreme Court of Canada was announced but after the Ontario Court of Appeal had decided that the Metropolitan Toronto fluoridation by-law lacked statutory authority, the Legislature of Ontario amended The Public Health Act, R.S.O. 1950, chapter 306, by Statutes of 1957, chapter 97, which authorized eight municipalities which were already fluoridating their water to continue to do so. These municipalities are: City of Brantford, Town of Brockville, Town of Deep River, Town of Fort Erie, City of Oshawa, Town of Thorold, Township of Tisdale and City of Sudbury, (Appendix II).

6. Immediately after our appointment, we considered how we should proceed in this inquiry. We soon became aware of the extent and complexity of the problem. We found that there was a tremendous amount of detailed scientific knowledge and a vast literature on this subject which had been accumulating over many years and which embodied the results of numerous tests, surveys and laboratory work. It was obvious that an adequate survey and appraisal of this extensive literature would have to be done, not only by members of the Committee but by specially selected persons who were recognized as experts within the various disciplines relevant to the technical facets of our inquiry. We divided the total problem, as we then saw it, into areas for detailed study and research which are listed in Appendix III.

7. We first consulted Dr. Roy G. Ellis, Dean of the Faculty of Dentistry in the University of Toronto. This is the only dental school in Ontario. Although Dean Ellis could not personally prepare a report for us, he did, at our request, recommend for this work three members of his staff - Dr. R. M. Grainger, Dr. G. Nikiforuk and Dr. K. J. Paynter, all of whom were and are well experienced in dental research. We requested, also, reports from Dr. E. W. McHenry, the Professor of Nutrition in the School of Hygiene and Dr. E. A. Sellers, Professor of Pharmacology, both in the University of Toronto and Dr. Carol Buck, Associate Professor of Preventive Medicine in the University of Western Ontario. These scientists were not appointed official advisers to the Committee; they were simply asked to review the literature in the particular fields assigned to them and to prepare comprehensive reports based on that literature.

8. While the above reports were being prepared, the Committee read many published articles dealing with fluoridation. Towards the end of 1959, the commissioned reports had been completed. We were then in a position to decide how we would proceed from this point. We were fully conscious, by then, of the wide public interest in the subject and the sharply conflicting views upon it sincerely held by many persons. We determined that public hearings should be held at which these views could be advanced, commented upon and tested by questions. We also decided that interested persons should be given the opportunity of filing briefs and sufficient time to prepare them.

9. In January, 1960, we inserted a notice in every daily newspaper published in Ontario stating that public hearings would be held at Toronto beginning May 2nd and that those desiring to make submissions to the Committee should deliver their briefs to our secretary by March 15th, (Appendix IV). This notice was amplified by a press release which advised the public that we had received detailed studies from well qualified medical, dental, nutritional and pharmacological experts, (Appendix V). Copies of these studies were given to all persons who signified that they intended to present a brief. In response to our notice and invitation, 91 briefs were received, (Appendix VI).

10. By the beginning of April, 1960, we had completed our digest of the briefs and from them obtained a clearer appreciation of the issues. It was now possible for the Committee to prepare and send to every one who had filed a brief a memorandum outlining in general the topics and sub-topics upon which we would hear evidence and argument at the public hearings and the order in which they would be considered, (Appendix VII). This we felt was necessary so that we might proceed in as logical a sequence as possible in unfolding the whole problem and at the same time this method would permit the Committee to concentrate upon and exhaust the evidence given in public upon each aspect of the broad question of fluoridation before moving on to the next phase. By following this procedure we hoped that unnecessary duplication of evidence might be avoided.

11. The main topics set out in the memorandum were:

i The effectiveness of fluorides in reducing the incidence of dental caries.

ii(a) The role of "trace" elements in metabolism and nutrition with special reference to fluorides.

(b) Oral hygiene, nutrition, dental care, etc.

iii Pharmacological, physiological and pathological effects of fluorides on the mammalian body.

iv Epidemiological and statistical evidence of the effects of water-borne fluoride upon non-dental organs and processes.

v Chemical, engineering and other features relative to the administration of fluoride and its control in municipal water supplies.

vi Civil rights and fluoridation.

12. The Committee visited the Brantford Municipal Waterworks plant in April and observed the operation of its fluoridating unit.

13. Several requests to hold hearings outside Toronto were received by the Committee. After giving them serious consideration, we declined to accede to them for three reasons. First, the problem of fluoridation in both its scientific and civil rights phases is the same everywhere in Ontario. It has no peculiarly local or geographic factors. Secondly, the procedure we decided to follow - proceeding by topics - would have had to be repeated at every place we held hearings and would have necessitated much repetition and added expense not only for the Committee but for the professional witnesses, our staff, and principal opponents and proponents of fluoridation. It would have occasioned a great deal of time in completing the public hearings and the preparation of this Report. Thirdly, there was, in fact, a great deal of duplication of evidence and submissions in the briefs and we were satisfied that evidence and argument upon every particular matter mentioned in the briefs would be covered by those whom we were confident would be attending the hearings at Toronto. Now that the hearings have been completed and we are preparing this Report, we can say that the decision to confine the hearings to Toronto did not in any way deprive us of the material and relevant information which we required in order to make a complete investigation within our terms of reference.

14. Public hearings were held at the Parliament Buildings, Toronto, on May 2nd, 3rd, 4th, 5th, 6th, 9th, 10th, 11th, 12th, and 13th. None of the witnesses were sworn. It is not the practice in commissions of this nature, where there are no issues depending for their solution upon the witnesses' veracity, to restrict the evidence to testimony under oath. In large measure we followed the procedure outlined in our memorandum and departed from it on a few occasions for the convenience of witnesses who had come from a distance. The experts we employed all gave evidence in explanation of their reports and were closely questioned by our counsel, members of the Committee and by members of the public attending the open sessions. Everyone present was given the opportunity of stating their views upon each topic and questioning the other witnesses. Full advantage was taken of this opportunity. The oral evidence was supplemented and illustrated by lantern slides, blackboard demonstrations and tape recordings. We were given samples of waters, pills and numerous pamphlets. Representatives of the press were in constant attendance, (Appendix VIII).

15. Although evidence given, both oral and documentary, and arguments advanced at the public hearings clarified some of the issues, nonetheless with respect to other issues, what we heard at public sessions suggested further lines of investigation. Also there were several persons who wished to give evidence and whom we wished to hear who could not conveniently attend the hearings in May. To accommodate these persons the Committee heard them at meetings on June 22nd, July 15th, August 2nd, August 9th, October 4th and October 19th. Among those who gave evidence at these closed meetings were Dr. G. L. Waldbott of Detroit and Dr. S. W. Leslie and Dr. W. R. Cameron, both of Toronto. The Committee spent a day with Dr. H. K. Brown and Dr. G. H. Josie of the Federal Department of Public Health. Members of the Committee on several occasions questioned Dr. A. E. Berry, the General Manager of the Ontario Water Resources Commission with respect to the control and supervision of water supplies in Ontario and the responsibilities of that Commission. In September, we learned that Dr. W. G. Senior, the Chief Dental Officer at the United Kingdom Ministry of Health, would be in Toronto in October and while he was here, the Committee interviewed him.

16. Before the public hearings commenced we received several requests, in fact demands, from opponents of fluoridation that we should insure the attendance of several American professional men who were known through their published writings to be opposed to fluoridation. Through our secretary we had for some time been in correspondence with Dr. G. L. Waldbott and Dr. F. B. Exner, both of whom had filed briefs and who told us they intended to be present at the public hearings. Dr. Waldbott later found he was unable to be here in May and we heard his evidence in June. In addition to Dr. Exner, Dr. A. A. London of Boonton, New Jersey and Dr. C. A. Brusch of the Brusch Medical Centre, Cambridge, Massachusetts, took active parts at the hearings by giving evidence and cross-examining witnesses and payment of their expenses was authorized by the Committee.

17. In several of the briefs, we were told that the proponents of fluoridation had adopted unfair, in fact dishonest methods in promoting their views and had resorted to falsehoods, suppression of evidence and intimidation and pressure through professional and

other associations. It was also stated that large companies whose selfish interest lay in selling fluorides were actively supporting the campaign for its introduction into municipal water systems. These allegations were repeated by several witnesses at the public hearings. The documentation supporting these statements dealt mainly with such activities in the United States. The same broad accusations were made against some of the Canadian proponents of fluoridation. It was also said that one large Canadian company was selling as a waste product fluoride compounds. We will not mention its name because we satisfied ourselves that this company does not offer for sale or sell the fluoride compounds for water systems. Even if it had, we are unable to appreciate the relevance of that fact for our purposes. It was also stated that certain Canadian scientific publications had declined to publish articles either opposing or questioning the fluoridation hypothesis and that on some occasions persons who were scientifically qualified, were denied the opportunity of stating their views at meetings of professional or other associations. No particular purpose germane to the scope of our inquiry would be served by probing into these allegations. The only possible effect of their truth would be that the Committee might have been denied some pertinent evidence and opinions upon the issues it was required to investigate. We did hear at length the leading professionally qualified opponents of fluoridation and have considered all the relevant scientific opinions to which we were referred or which we found through our own efforts. No witness who appeared before us, whether for or against fluoridation, ever suggested that we were proceeding in ignorance of any relevant and material information and opinion which would assist us in reaching our conclusions.

18. The Committee obtained further information from additional reports, correspondence, questionnaires and surveys. In this Province, numerous municipal water supplies are naturally fluoridated and eight municipalities are adding fluoride to their water. In many areas of Ontario, the inhabitants have been ingesting water with a measurable concentration of fluoride all their lives. Careful health records have been maintained for a great many years. Studies have been conducted in several areas of this Province directed to the effect of fluorides in water. As will appear later in our Report, we have taken full advantage of the information which is available close at hand and which we felt we were in a position to

test, check and assess.

19. It was not until December 1st, 1960, that we decided that we had finally acquired the knowledge that the importance and difficulty of the problem demanded and upon which we could, with confidence, prepare this Report and express the opinions and make the findings contained in it.

PART II

DENTAL CARIES AS A HEALTH PROBLEM IN ONTARIO

CHAPTER 1. Incidence of Dental Caries

20. That dental caries is a much more serious problem than most people realize, or are willing to admit, can no longer be doubted. The magnitude of the total dental health problem - dental caries, malocclusion, periodontal disease, etc., - generally not appreciated, is so great that it should, and indeed must, command the attention not only of health authorities, but of the people of Ontario themselves.

21. The inherent nature of dental disease is perhaps the greatest reason for the lack of attention on the part of the public and the relative disinterest on the part of scientists, in conducting fundamental research in this field. Perhaps this is due, in part at least, to the fact that dental disease is only infrequently a direct cause of death. That the manifestations of dental disease are not always apparent is another reason for the public's lassitude which is evident concerning this major public health problem. Yet there is little doubt that the total national physical handicap due to dental disease and poor oral hygiene is such as to place it as a major health problem.

22. The incidence of dental caries is high. It is high in every age group and it can be stated that almost every man, woman, and child in our country has some degree of tooth decay. Surveys in the Toronto district indicate that dental caries affect infants as early as one year of age. Almost 20 per cent of the two-year-old children have active tooth decay and more than 80 per cent of the elementary and primary school children in Toronto have cavities. By the age of 19 over 98 per cent of the high school pupils have decaying teeth. Less than 1 per cent of the adult population remain free of tooth decay, Compton (1959), City of Toronto (1958), Mehta (1955).

23. The magnitude of this problem may be stated in another

way. The average number of decayed, missing, or filled deciduous (baby teeth) and permanent teeth experienced by age 19 for Toronto children is approximately 19. By age 55 the average number of such teeth per person had risen to 30, which would have entailed the treatment of about 50 cavities per person. It should be appreciated that it is much more difficult to obtain adequate information about the amount of tooth decay among the pre-school and the adult population than among the school-age groups. The organizational problems and the costs involved in surveying such groups are so much greater.

24. Decay of the deciduous teeth is significant. It cannot be said that just because these teeth will fall out their care should be neglected. In Ontario by the age of 6 the average child will have acquired nearly eight cavities. At eleven years 20 per cent of the population have 6 or more decayed, missing or filled permanent teeth. The true significance of this is that a child with 8 or more badly decayed teeth has lost virtually all his masticatory ability.

25. It must of course be realized that there is a wide range of individual variation in the susceptibility to tooth decay. At the same time, however, it should be recalled that there are many areas, not only in Ontario but throughout Canada, where there are many fewer dentists per unit of population than in Toronto, that there are many hundreds of thousands of people in this country who do not enjoy the same high standard of living as do those in the city of Toronto, and that there are many places where school health services are not as readily available or as comprehensive as in Toronto. The incidence of dental caries in our total population is not only high, it is alarming.

26. It is not sufficient, in evaluating the extent of dental caries, simply to count the number of cavities found in each tooth. A more accurate index was required and throughout the world the "D.M.F. rate" is used to express the statistical evidence of dental caries. "D.M.F." means the number of decayed, missing, and filled teeth per 100 children or per 100 permanent teeth at specific ages. It is a quantitative measurement of the amount of

dental caries. The rate is determined on a statistical basis within a population. If an adult tooth is "filled" it is obvious that it was "filled" because of tooth decay. It an adult tooth is "missing" it is primarily because the tooth was so badly decayed that its extraction was necessary. There are, naturally, some exceptions to this as in the case of extraction for orthodontal reasons, as a result of "accidents", and extractions necessary as a result of periodontal disease. "Wisdom teeth" are excluded from consideration. In general, in the school age and adult population the D.M.F. rate has been found to be an accurate index of tooth decay even though it does not take into account either the decay on the several surfaces of a particular tooth or the extent of the individual lesions.

27. There is a possibility that geographical differences as such may play some part in the incidence or prevalence of tooth decay. There are many areas with D.M.F. rates comparable to the Toronto rates - British Columbia, Muskegon (U.S.A.), Boulder (U.S.A.), Kilmarnock and Ayr (Scotland). Rates in New Zealand are considerably higher than the above. Reports indicate that rates in central European countries, e.g. Hungary, are lower than in Toronto. A report from the Ministry of Health of Israel shows that for 4,457 14-year-old children the average D.M.F. was only 2.6. This is in contrast to the Toronto 14-year-old group with approximately 7 D.M.F. teeth. Other reports show similarly striking differences in adults. In Toronto, adults 20 to 24 years of age have a D.M.F. rate of 17; in Singapore the rate for servicemen, with an average age of 21 1/2 years, was 13.3 for Chinese, 8.4 for Malayans, and 8.8 for Indian and Pakistani nationals. This latter study of McCombie (1958) is of special value because the methods employed were the same as those used in surveys in Ontario and British Columbia. These and other comparable surveys indicate that the dental caries rates vary according to cultural and racial background. It is not unlikely that the high rates are closely associated with dietary habits, not least of which is the consumption of foods and beverages not usually taken at mealtimes.

28. It should be recorded here that the accuracy of the D.M.F. index has been questioned on the basis of human error in examination. It has been stated that no two examiners would necessarily arrive at the same conclusion, would not locate the same number

of cavities and that without a thorough x-ray examination the data would be inadequate. Admitting that these criticisms have a degree of validity, it is our opinion that the consistency of results obtained by trained teams of examiners in well-conducted epidemiological surveys are sufficiently accurate to establish the D.M.F. rates under the conditions of the surveys. In other surveys and planned investigations the one examiner has examined all of the persons involved in the survey. It is on the basis of these adequate examinations that we accept the validity of the D.M.F. rate index as being specifically indicative of the incidence of dental caries.

29. Other criticisms have been made of the D.M.F. rate. For instance, Dr. Exner stated:

> "I shall be prepared to show that since there is no way to measure tooth-decay, and no way to apply it if there were, any claim of reduction in the amount of decay is without substance... There is no way in which tooth-decay can be measured and no conceivable unit in which it can be expressed. The method now in use (D.M.F.) is mathematically unsound and quantitatively meaningless."

Yet Dr. London, another witness who gave evidence at the hearings, suggested that the D.M.F. rate reporting could be improved:

> "Register the number of cavities. There will be a number of children who have three cavities - a number of children who have four cavities - in each age group and then we can see the high and the low... You can still average them, but it gives you an opportunity to not only see just the averages alone, but to see what the range is in each particular group."

30. We are not prepared to accept Dr. Exner's criticism of the basic value and accuracy of the D.M.F. rate as an index of dental caries or Dr. London's suggestion as being statistically superior to the accepted method of recording. We believe that regardless of a few minor defects, the D.M.F. index is presently the only quantitative tool available for measuring the dental caries rate in

a population. It is perhaps a cruder method than one would find used in a research laboratory under ideal experimental conditions, but in an epidemiological study of segments of the population it has been used satisfactorily and found to be statistically adequate. If, on the basis of our present knowledge, a completely new survey were to be undertaken, under as ideally controlled conditions as possible, we would suggest that the quantitative measuring tool for determing tooth decay would "weigh" the carious lesions in terms of the amount of decay. This would indicate the decay by tooth surface and the amount of tooth destroyed. We believe that for purposes of comparison of presently known data wherein the D.M.F. rate has been used as the index the general conclusions drawn are valid.

CHAPTER 2. Nature of Dental Decay

31. It is fully appreciated that the susceptibility of individuals to dental caries varies a great deal. That there may be familial factors involved in this difference in susceptibility is commonly assumed, although not necessarily proven. That the children in one family are particularly prone to dental caries while the children of another family in the same area are more resistant to caries, is the experience of most dentists. However, even though the causes of dental caries are not fully understood there is general agreement that the earliest damage to the surface of the tooth is caused chiefly by acids produced during bacterial or enzymic fermentation of food particles adhering to the teeth. These acids damage the enamel surface of the tooth and subsequently dental decay results from the invasion and further destruction of enamel and dentine by bacterial action. Most witnesses, commenting on the nature of dental decay, were of the opinion that foods which were high in carbohydrates (sugars and starches) were chiefly responsible for giving rise to acid fermentation in the oral cavity.

32. Dental care plays a very vital role in the whole problem of dental caries but dental care, in the form of adequate dental examinations and subsequent fillings, does not necessarily reduce the susceptibility of a person to more tooth decay. Treatment alone does not stem the advance of dental decay. It is the total oral environment which is significant.

CHAPTER 3. The Adequacy of Dental Care

33. In a country like Canada with a Gross National Product of 34.6 billion dollars and a per capita personal income of $1,487.00, it is distressing to come to the realization that the dental care of our population is so inadequate. The Canadian Sickness Survey (1953) revealed that in 1950-51 less than one family in three had an annual expenditure for dental services! And furthermore, it was reported that of the actual services rendered a considerable part was for the relief of pain only and not for restorative treatment. It is considered that only about one-third of the population of Ontario obtains anything which might even approach adequate dental care. To put this another way, two-thirds of the people of the Province of Ontario do not get adequate dental care. These figures are substantiated by both the Canadian Public Health Association and the Canadian Dental Association.

34. Although such facts have been brought to the attention of the public in general and to parents in particular by various agencies, there is apparently a widespread indifference to the problem of dental health and in some areas actual neglect on the part of parents with respect to dental caries in their own children. All of the bulletins, the pamphlets, the news releases of the Federal and Provincial Health Departments and the examining services of the schools and other agencies will not change the inadequate dental care of our people until the people themselves show more personal concern with this difficult but important problem. That poor nutrition and improper food are significant was stressed by many witnesses. That ordinary mechanical cleansing of the teeth and mouth is important was also emphasized. If there were a sufficient number of dentists available to do the work, that remedial filling of cavities alone is not the whole answer to the dental caries problem was consistently emphasized.

CHAPTER 4. The Cost of Dental Care

35. As stated above, only about one-third of the population receive adequate dental care. A considerable number request and receive services for the relief of pain only. About one-third of the population make no expenditure whatsoever for dental care. Even so,

the annual cost of treatment of dental diseases - the majority of which are dental caries or their ramifications - is presently in excess of 100 million dollars in all of Canada, about 47 million in Ontario, and approximately 17 million in Metropolitan Toronto (Canadian Dental Association).

36. In order to provide adequate dental care, assuming that the people wish to have it, we would require many more dentists than are presently available in Canada. On the basis that over 95 per cent of the population require the services of dentists it should be recalled that in 1920 the ratio of dentists to population was 1:1900, while in 1959 the ratio was 1:2400. One expert witness stated that at the present time it is impossible for the population, if they all demanded dental care, to receive adequate care due to the lack of dentists. He stated that in his opinion it is not economically feasible for a country such as Canada (or the United States) to graduate the number of dentists that would be required to fill all of the teeth that require filling. Another witness, however, claimed that the treatment of caries only forms a small part of the practice of dentistry, that stressing the problem of dental caries was misleading since not more than 30 per cent of a dentist's time was spent in such work. This was not confirmed on the basis of data compiled from a survey which was initiated by the Committee and conducted in three representative cities in Ontario. The number of dental appointments for the purpose of treating dental caries varied from 54 to 86 per cent of all appointments. On the basis of hours of dentists' time spent treating dental caries, in the same three cities, there was a variation between 56 and 87 per cent. On the average 65 per cent of the dental appointments were for the treatment of caries which occupied 68 per cent of the dentists' hours of practice. In the United Kingdom, where a National Health Service has been in operation for many years, the cost of filling decayed teeth alone is 40 per cent of the total cost of all dental services. This does not include the cost of other dental work specifically related to, or the sequelae of, dental caries.

37. The cost of dental care and the need for more dentists, thoroughly discussed at the hearings and briefly mentioned above, are of serious concern but are not specifically relevant to the investigations of the Committee.

CHAPTER 5. Prevention - A New Approach

38. Few, if any, witnesses declared or even suggested that the traditional methods of treatment of dental caries were more than temporary methods and that treatment did reduce the overall and ultimate incidence of dental caries. Many witnesses stressed the need for a change in philosophy towards dental health - a change in thinking in terms of prevention rather than treatment. Many argued that little progress had been made in the improvement of the dental health of the people by any of the educational efforts so far instituted. That there should be implemented a sound, concerted programme aimed at supplying accurate nutritional information to the people of Ontario as a part of a total programme of general health and dental health education was suggested by one expert witness, a view which is shared by the Committee. But the "new approach" as stressed many times by many witnesses was the "preventive" approach. The magnitude of the economic and dental manpower problems precludes satisfactory control of dental disease without considering the reduction of the incidence of dental disease. In other words, the preservation of natural dentition can only be achieved by adopting preventive measures.

CHAPTER 6. Biological Structure of the Tooth

39. In order better to understand the mechanism of tooth decay and the influence of fluorides in preventing such decay, it is appropriate that a brief and general description of the structure of the tooth be given as presented by various expert witnesses. Reference should be made to the accompanying Figure 1 which illustrates, in a diagramatic way, the normal tooth and its supporting structure. The major part of the tooth consists of a hollow core of dentin composed of a mineralized ground substance containing embedded collagen fibres. The dentin is non-cellular. It is, however, preforated by microscopic canals which run from its inner to its outer surface and which contain cytoplasmic processes of the cells which were responsible for its initial production. The crown of the tooth is covered with a thin layer or cap of enamel - a non-cellular, highly mineralized tissue of ectodermal origin. Less than 1 per cent of the enamel is organic, this small portion being chiefly a keratin-like protein. The rest is a complex calcium-phosphate

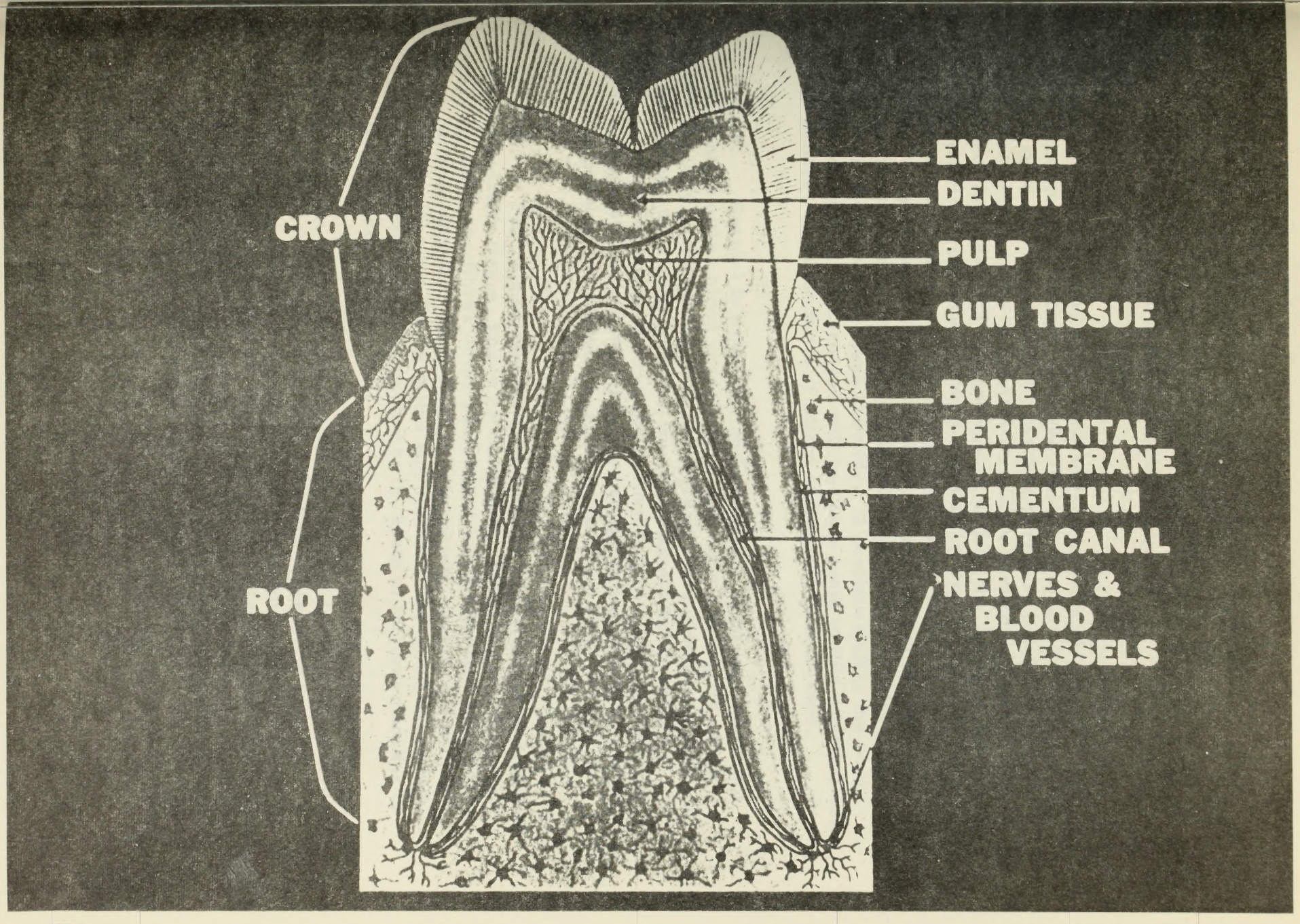


Fig. I. A NORMAL TOOTH AND ITS SUPPORTING TISSUE

salt in the form of hydroxyapatite crystals.

40. The enamel of the tooth develops in two stages. In the first stage the matrix develops during a specific limited period of time for each tooth. During this period metabolic disturbances may affect the matrix formation resulting in permanent abnormalities such as hypoplasia. During the second stage enamel calcification occurs immediately after the matrix is completed. The calcification process is terminal maturation and as such factors which affect mineralization of the enamel exert their greatest effect during this period. The mineralization of enamel does not cease abruptly. It continues after the teeth have erupted. References will be made again to this mineralization process when the mode of action of fluoride is discussed.

41. Enamel is avascular and acellular. That is, it does not contain either blood vessels or tissue cells. The cells which initially produced the enamel degenerate and disappear. No new enamel-producing cells are formed in humans and therefore cytological repair of damaged enamel cannot occur. This is in contradistinction to the ordinary healing and repair process of damaged or cut tissues, e.g. skin, muscle, etc.

42. The root of each tooth is covered with another mineralized connective tissue, known as cementum, which forms the medium by which the fibres of the periodontal membrane hold the teeth in their sockets. Gum tissues, or gingiva, enclose the neck of each tooth much like a collar and normally the epithelial component of the gingiva is attached to the tooth at the lower border of the enamel.

43. As mentioned above, the major part of the tooth consists of a hollow core of non-cellular dentin. This is the material underlying the enamel and extends downwards to form most of the root. Inside the hollow core of dentin is the pulp of the tooth which contains both blood vessels and highly sensitive nerves. The dentin is much softer than the enamel being quite similar to ordinary bone both in composition and character.

44. Although there is evidence of teeth being formed as early as six to seven weeks of life in utero, the mineralization of the deciduous teeth begins some 12 to 16 weeks before the birth of the child. While mineralization of the permanent teeth begins at birth, with the first molars, approximately one-third to one-half of the enamel of the primary teeth has developed by that time. It is not to be expected, however, that when the teeth protrude through the gums they are fully formed. Only the enamel, or crown, is fully developed. The roots are still developing.

45. Most children have all of their primary teeth in their mouth at two to three years of age. The mineralization of the enamel is completed at that time in the first molars, which erupt at about 6 years, at 7 to 8 years in the second molars, which erupt at about 12 years, and at 12 to 16 or 17 years in the wisdom teeth.

46. Normally the first or front deciduous teeth are lost at about 6 years of age. The remaining deciduous teeth are lost by the time the child is 11 or 12 years of age. At about the time when the child loses or has lost the front teeth the permanent teeth start coming in to replace them. There are twenty deciduous teeth in children. The child, as mentioned, loses all of these. Adults, on the average, develop 32 permanent teeth.

CHAPTER 7. Mechanism of Decay

47. Dental caries, or tooth decay, is a lesion of the hard tissues of the teeth. The initial process begins as a microscopically small lesion on the surface of the tooth's enamel and is considered to be a decalcification of the inorganic elements by organic acids produced by bacterial enzymatic action on carbohydrates. Proteolysis of the organic matrix follows the initial decalcification, Easlick (1948). If the initial small lesion remains unchecked the decay process continues until it destroys the enamel and eventually causes the loss of the tooth. Since tooth enamel is avascular and acellular, and therefore does not have the power to heal, the lifetime caries experience of an individual past childhood is indelible.

48. While most of those who expressed an opinion agreed that the mechanism of decay was most likely to be as cited above, two witnesses definitely did not agree. Dr. Brusch simply stated, "We don't know what causes tooth decay." The other, Dr. Exner, stated:

> "Lately Albert Schatz ... has come up with what seems to me to make a lot more sense; What he calls proteolysis chelation ... violent controversy in ... dental theory of which of these two theories is right would indicate that we don't know the cause of tooth decay and I would suggest that possibly both of them were wrong."

49. We found no confirmation of Dr. Exner's opinion that there was any "violent controversy" in respect of the mechanism of dental decay. Bacterial action undoubtedly is a major factor since it has been shown that in laboratory animals kept in a bacteria-free environment there is no tooth decay. It is known, too, that bacteria act on foods, and particularly foods of a carbohydrate nature, producing organic acids, which acids act on the mineral parts of the tooth. This is generally accepted as being the initial process involved in dental caries.

50. The length of time required for such organic acids to produce an effect on the enamel is not specifically known. It is known, though, that following a mouth rinse of a concentrated glucose solution the amount of acid produced in the mouth is great and that in approximately five minutes an acidity concentration develops on the tooth surface which would be harmful to the tooth enamel. This is a rapid process. After this point, however, the actual etching of spots of enamel is much, much slower.

51. No evidence can be found to substantiate the contention of one witness that a lack of calcium was a predominent factor in the cause of dental caries. Another witness stated, "I want to point out that nutrition is a definite factor in the causation of decay." With this latter statement, which is so well appreciated by almost everyone working in the health fields, there is no

disagreement.

52. Another expert witness, in discussing dental caries, stressed the point that it was a disease of the younger age group - of youth - and that if they can be brought along to age twenty or twenty-one with their teeth in a reasonably good state, and that if they are cared for "from there on, there is no reason that they should not do reasonably well in later life."

CHAPTER 8. Known Methods of Reducing Dental Caries

53. None of the witnesses, lay or expert, examined during the hearings of the Committee felt that the efforts which had been made to educate the public in matters of better oral hygiene had materially reduced the incidence of dental caries. Nor was such a possibility realistically expressed in any of the 91 briefs presented to us. On the other hand, it was frequently admitted that improved oral hygiene does have a beneficial influence in reducing tooth decay.

54. The influence of nutrition, during the period when the teeth are developing, both in utero and in childhood, is of vital importance. But food habits, once established in any society, are extremely difficult to change and especially so under a democratic system of government in peacetime. Even so, there are many families who are conscious of the values of a good and well balanced diet and attempt to control the foods eaten by their children. In their own homes they may manage fairly well, but their total efforts may still fail. Children and young adults seek acceptance of their fellows. The forced exclusion of certain habitual dietary items outside of the home and even within the home is virtually a disciplinary impossibility. One witness, drew to our attention, however, an oral hygiene programme introduced into the schools in Philadelphia. This programme consists, essentially, of banning "soft drinks" and candies in the schools, intensive oral hygiene education and the establishment of additional clinics in the schools.

55. When one has to rely on one's own initiative, cooperating with himself as it were, to practice good oral hygiene the results are not likely to be very satisfactory. That this is the situation among the general population is admitted. At the same time there seems to be no doubt that good oral hygiene plays a significant role in reducing the incidence of tooth decay. If it were possible, therefore, on a total population basis, to have a supervised oral hygiene programme, implying that there would actually be a responsible, daily supervision of the children as far as adequate brushing of the teeth after each meal was concerned, a considerable reduction in dental caries could be expected. However, such a programme would be virtually impossible to put into effect and to maintain. But the fact remains that oral hygiene is of great importance in the problem of tooth decay.

56. The roles of vitamin D, calcium, phosphorus, and of ascorbic acid (vitamin C) in the prevention of dental caries were examined. They are important factors but are so primarily as integral components of a properly balanced diet which is as vital for general health as for dental health.

57. One opponent of fluoridation presented extensive data to show that nutrition was all important in the "production of good teeth" and "the reduction of dental caries." Dr. McHenry, a nutritional expert, felt strongly that nutritional education of the children and the parents needs to be intensified in Ontario, and continued, "The obtainment of such supplies (of essential nutrients) by expectant mothers, by infants and by children should be vigorously promoted by educational measures. The necessary foods are available in Ontario and could be used in proper amounts except for indifference and ignorance."

58. In this connection a recent study of school children in Toronto indicated that one-quarter to one-third of the children do not get sufficient milk, that a considerable number of children do not get sufficient fruit and vegetables - sources of ascorbic acid - and many children do not get sufficient vitamin D. Certainly this problem is not economic since the study showed that these children were getting more meat than they needed and meat is our most expensive food. That this state of poor nutrition

is to be found in this province - with its extensive orchards, its productive dairy farms, its high standards of education and its high standard of living - is as shocking as it is true.

59. A special study conducted for the Committee in Stratford, a city of moderate size in Ontario, showed that families use meat generously but that children are not given adequate amounts of some of the other needed foods. The findings supported the conclusions reached in the Toronto study. When we know that adequate supplies of calcium, of phosphorus, and of vitamins C and D, all readily available to us, are so essential to general good health and, in this particular instance, to the formation of good teeth and at the same time realize that the children of this Province are not being given these required nutrients in adequate amounts in the proper foods, it is impossible not to conclude that we should intensify, with vigour and determination, the programme of dental education - and indeed of nutritional education - in this Province. This we believe is necessary even as we, at the same time, commend those municipalities which are making headway in this connection.

CHAPTER 9. Conclusions

60. i We are convinced that the incidence of dental caries both in Ontario and throughout Canada is of such magnitude that it must be regarded both as a serious and as a major public health problem.

ii We are willing to accept the data which unquestionably shows that even the adequate treatment of dental caries in the whole population is beyond the resources of the dental profession.

iii It is our opinion that the dental profession can provide more effective service to the public only when the incidence of dental caries has been materially reduced.

iv We are convinced that the treatment of dental caries alone does not, and will not, control or reduce the ultimate incidence of tooth decay.

v We are convinced of the importance of good oral hygiene, but at the same time, we recognize the limitations of a good oral hygiene programme in our society.

vi We acknowledge, with some degree of astonishment and with much concern, the inadequacy of our overall nutrition in Ontario.

vii We believe that an intensification of the programme in nutritional and health education is essential.

viii We firmly believe that the reduction of dental caries is a problem of prevention, not one of treatment.

PART III

FLUORIDE AND DENTAL CARIES

CHAPTER 1. Basic Historical Background

61. Although some experimental work was conducted in 1874 by Dr. Erhardt on fluoride in dogs' teeth, perhaps the first observations which indicated a relationship between ingested fluoride, the enamel of human teeth and tooth decay, were made by Sir James Crichton-Browne in 1892. The great interest in fluoridation today, however, dates back to the observations of Dean in the United States and similar and even earlier observations in England.

62. Prior to the finding that fluoride and "mottled" enamel were associated, the question of an association between "mottled" teeth and dental caries was discussed in a number of publications between 1916 and 1929. Among the earliest attempts to relate specifically "mottled" or fluorosed enamel to dental caries are the studies by Bunting and his colleagues (1928) and McKay (1929) which indicated a reduced incidence of dental caries in children showing fluorosed or "mottled" enamel. These observations gave rise to the now classical epidemiological studies of the United States Public Health Department by Dean and his associates (1938, 1939, 1941, 1942, 1943). These are the basic studies from which water fluoridation as a means of preventing dental caries arose, and, therefore, merited detailed consideration by the Committee.

CHAPTER 2. The Chemistry of Fluoride

63. Fluorine, in chemical combinations, occurs naturally in much of the material comprising the earth's crust. Fluorine, as an element, is rarely, if ever, found in nature. In its combined state it is a constituent of certain minerals found in rocks and soils and in varying small amounts in most available water supplies. In such water supplies all of the minerals present in solution, provided their concentrations are not too high, are in ionized form. That is, the fluorides present are not in the

form of fluorine but in the form of fluoride ions.

64. These fluoride ions naturally occurring in water are derived from the solution of a wide variety of mineral salts such as calcium fluoride (fluorite), micas, apatites, sodium fluoride, sodium silicate fluoride, fluorapatite, etc. When such compounds dissolve in water, at low concentrations the fluoride ion passes into solution and remains as a fluoride ion regardless of the salt from which it originally came. The dissociation of the fluoride ion depends in general upon the solubility of the original salt, on the temperature and on the pH - a measure of acidity or alkalinity - of the water. To re-emphasize the significant point - the fluoride ions whether in an aqueous solution of sodium fluoride or of calcium fluoride or of stannous fluoride are exactly the same. They are fluoride ions.

65. Since the question of fluorine, fluoride, fluoride ions, fluoride molecules, etc., was discussed and opinions expressed in several briefs and by many witnesses, some favouring fluoridation and others opposing fluoridation, the relevant passages in the briefs and in the testimony were submitted to recognized university teachers of chemistry for their comments. One representative opinion is as follows:

> "The terms fluoride ion and fluorine ion were used in different briefs. These evidently mean the same thing, the F^- ion. There is no other ion to which they could refer. The term used by most chemists is 'fluoride' ion.
>
> "The point was made in various briefs that a difference might exist between fluoride artificially introduced as sodium fluoride, and fluoride from natural calcium fluoride. Although the sodium and calcium would behave differently, the fluoride ion would be exactly the same in its properties, whether derived from the sodium or the calcium compound. The analytical and chemical behaviour of the fluoride ion would be indistinguishable. In particular, a chemist might prepare two solutions: (i) he might dissolve sodium

fluoride and calcium fluoride together in a large quantity of water. If he used equivalent amounts of the various compounds, the solutions would be identical. The origin of the fluoride could not be discovered by any known means. The application of this to the fluoridation of water lies in the fact that water supplies will generally contain traces of sodium salts, and if the water has any degree of hardness it will contain calcium salts also; in such cases it will be impossible to distinguish between fluoride derived from calcium fluoride in rocks, and added sodium fluoride.

"It was suggested in some submissions that the difference would lie in the formation of sodium fluoride molecules or calcium fluoride molecules in the water, as opposed to sodium ions, calcium ions, and fluoride ions. I do not believe that such molecules would form. Even in the solid state sodium fluoride and calcium fluoride contain ions and not molecules, and there is no evidence of such molecules in solution. Some of the properties of these, or similar solutions, have been interpreted in the past as affording evidence of molecules; but the general opinion amongst chemists now is that these solutions contain only ions, and that the properties in question are due to long range forces of attraction or repulsion between the charges on the ions.

"One submission mentioned the possibility of hydrofluoric acid molecules being present. This is correct, but would apply equally to fluoride derived from calcium fluoride or added sodium fluoride. The extent of formation of hydrofluoric acid would depend very much on whether the water contained acidic (e.g. carbonic acid) or basic (e.g. calcium bicarbonate) substances. In the absence of such substances, one hydrofluoric acid molecule would be present for every 7,000 fluoride ions present. In a person's stomach, where the conditions are strongly acid, the proportion would be about 100 hydrofluoric acid molecules to one fluoride ion. In blood the proportion would be one hydrofluoric acid molecule to about 18,000 fluoride ions. These ratios apply

equally to sodium fluoride or calcium fluoride solutions.

"The same submission mentioned the possibility of bifluoride ions, HF_2^-. These would be present in very small numbers, again in amounts depending on the acidity of the water: in water without other acids or bases, and with fluoride added to the extent of one part per million by weight, there would be one bifluoride ion for every 30,000,000 fluoride ions present. Again, these numbers apply equally to fluoride derived from sodium fluoride or calcium fluoride."

66. Such is the explanation provided by the leading inorganic and physical chemists whose opinions we sought on this question. Nevertheless some witnesses who had only a passing acquaintance with chemistry, and other witnesses who were also strongly opposed to fluoridation and who were not chemists, challenged this established concept of the ionization theory. We accept the explanation of the several professors of chemistry that at the concentrations of fluoride with which this Committee is concerned the fluorides are in solution in the water as fluoride ions.

67. Several witnesses stressed the point that fluorides, occurring naturally in water supplies were "different" than fluorides which had been added "artificially" to water supplies, otherwise low in fluorides, in the form of sodium or calcium fluoride. That they are different because in the one instance "God put it there" and in the other instance because "man put it there" does not alter, in our opinion, the fundamental chemical concept that the fluorides in both instances are in the form of fluoride ions and are identical in both.

68. One witness made the following statement:

"Nobody has ever found in living beings or in trees or plants or in the ground a true organic fluoride chemical. All organic fluorides have to be manufactured by man synthetically in factories."

Contrary to this statement, fluorides do occur in organic as well as in inorganic forms. The plant dichapetalum cymosum, "gifblaar", for example, contains fluoroacetic acid and dichapetalum toxicarium, "brokeback", contains fluorooleic acid. These plants are toxic and apparently are found only in parts of Africa. Other than the dichapetalum family no other plants are known to be able to synthesize toxic organic fluorides.

CHAPTER 3. The Fluoride Hypothesis

69. In different localities in the United States the concentration of fluoride in the water supply varies from almost zero to 14 parts per million (p.p.m.). A pilot study by Dean (1938) of the United States Public Health Service, revealed a significant difference in dental caries prevalence between children living in areas where fluorosis was endemic and children in areas where such fluorosis was not present. It was from the data of this study that Dean formulated the hypothesis that "the factor or factors responsible for partial inhibition of dental caries was present in the domestic water supply, and also was operative whether the tooth showed macroscopic evidence of mottled enamel."

70. The next study of major significance involved 1,581 twelve- to fourteen-year-old children in four cities - Galesburg and Monmouth in Illinois, 1.8 and 1.7 p.p.m. of fluoride in their respective water supplies, and the nearby cities of Quincy and Macomb, used as control cities, where the municipal water supplies were relatively free of fluoride. Observations were limited to children who had used their respective water supply from birth. It was found that the children in Quincy and Macomb, the low fluoride communities, had three times the amount of dental caries as did the children in Galesburg and Monmouth, the fluoride areas, Dean et al (1939).

71. It was natural that Dean and his associates (1941, 1943) would design a study to find out whether or not there was a concentration of fluoride low enough to eliminate the complication of dental fluorosis and yet inhibit dental caries. A clinical study of 7,257 white children, age 12 to 14 years, in 21 cities of 4 states, who had used the local water supply since birth, was carried out. The fluoride concentration in the various water

supplies ranged from 0.0 to 2.6 p.p.m. It was observed that a striking reduction of caries, approximately 65 per cent, with no fluorosis of esthetic significance was associated with a fluoride content of the water of approximately 1.0 p.p.m. No additional benefit was observed when the concentration of fluoride in the water exceeded 1.0 p.p.m. and the benefits became insignificant when the fluoride concentration fell below 0.5 p.p.m. This significant study was published by Dean in Publication No. 19 of the American Association for the Advancement of Science, 1942.

72. These original findings of the United States Public Health research teams have since been repeated and corroborated not alone in other areas of the United States but as well in Canada by Box and Hodgins (1944), by Brown (1951), in England by Murray and Wilson (1942), Wilson (1941), Weaver (1944), in South Africa by Ockerse (1944), in the Ukraine by Gabovich (1950), in Italy by Tempestini (1949), in Greece by Mavrogordato (1951), in Hungary by Adler (1950), Adler et al (1951) and in more recent studies in other parts of the world.

73. That the caries-reducing effect of fluoride extends into adult life has been clearly demonstrated in England by Forrest et al (1951), in Hungary by Adler (1951), in the Argentine by Herr and Galissier (1952), and in the United States by McKay, as early as 1918, by Deatherage (1943) and by Russel and Elvove in 1951. The latter study compared the average number of decayed, missing and filled permanent teeth in adult natives of Boulder (water containing 0.1 p.p.m. of fluoride) and Colorado Springs (water containing 2.5 p.p.m. of fluoride) in the ages of 20 to 44 years. The natives of Colorado Springs had approximately 60 per cent less dental caries than those of the Boulder group. The adults in the non-fluoride area of Boulder had lost 4 times as many teeth as persons of the same age group living in Colorado Springs. It is appreciated that, as Dr. London pointed out in his evidence, the water of Colorado Springs contained 2.5 p.p.m. of fluoride.

CHAPTER 4. Fluoride Concentrations in Water

74. These epidemiological studies established a specific relation between dental caries and the ingestion of water which naturally contained fluorides. The optimal concentration of fluoride was considered to be 1 part per million in the municipal water supply. This was deduced from the observations that the caries inhibiting effect at this concentration is maximum and the production of fluorosed enamel insignificant. It was, then, natural that this hypothesis should be subjected to experimental testing by the addition of fluoride to municipal water supplies of selected cities and by using other cities of the same size, economic level, and ethnic backgrounds as control cities. This was done in the United States, in Canada, and in England.

75. Brief reference has been made to the natural occurence of fluorides in water supplies in the United States. Chemical analysis of water and/or the finding of endemic dental fluorosis has indicated that fluoride ion in metabolically significant concentrations occurs in widely distributed areas of the world. Indeed, in view of the widespread occurrence of fluoride throughout the world, it would be surprising if water from wells, underground streams, rivers, etc., did not contain, in many areas, appreciable amounts of fluoride in solution. Dean (1957) compiled a list of areas in which the water supplies contain significant amounts of fluoride (Appendix IX).

76. In Canada, there are, as would be expected, many areas which contain appreciable amounts of naturally occurring fluoride in the municipal water supply. Although there are very few municipalities outside of Ontario which have natural fluorides in their water in excess of 1 p.p.m., there are at least 42 such areas known in Ontario. Arthur, Aylmer, Bothwell, Brussels, Dresden, Essex, Forest, Glencoe, Hagersville, Lucknow, Ridgetown, Ripley, Stratford, Tillsonburg and Zurich are among those in this category. Because it will be of significance later it may be emphasized at this point that neither Sarnia nor Brantford are listed since they have less than 0.05 p.p.m. of fluoride naturally present in their source of communal water supply (Appendix X).

77. In the United States there are over 1,900 cities and towns (1959) with a combined population of 7 million people which have water supplies that contain naturally occurring fluoride in a sufficiently high concentration (0.7 p.p.m. or more) to exert an effect on dental caries. In Ontario there are more than 50 known municipalities with 0.7 p.p.m. or more fluoride in their natural water supply providing communal water to 200,000 persons. And unquestionably there are many thousands more who for generations have consumed water, containing significant amounts of fluoride, from their own wells.

CHAPTER 5. Controlled Fluoridation Studies

78. As suggested previously, controlled fluoridation of communal water supplies was a logical extension of the epidemiological studies on populations living in areas with naturally fluoridated waters. Because most water supplies contain only trace amounts of fluoride, "fluoridation" implies a controlled adjustment of the concentration of a communal water supply to 1 part of fluoride to 1 million parts of water.

79. In 1944-45 long term (ten-year) investigations of controlled fluoridation of community water supplies were commenced. These studies were well planned, carefully carried out, and the data arising from the studies subjected to careful statistical analysis. They were epidemiological studies carried out within a freely moving population and should not, indeed they cannot, be compared with labpratory experiments carried out under ideally controlled research conditions. This matter will be referred to later in this Report.

80. In the so-called Grand Rapids Study in Michigan, the three cities of Grand Rapids, Muskegon, and Aurora were selected. The fluoride content of their water was 0.2, 0.2 and 1.2 p.p.m. respectively - Aurora having had that concentration since 1900. The incidence of dental caries was established by an examination of 19,680 children, of different age groups, with a continuous residence in Grand Rapids. In Muskegon 4,291 children were examined and in Aurora 5,116. Such examinations established the base-line of the study. In 1944 the fluoride content of the water

supply of Grand Rapids was mechanically raised to 1 p.p.m. The water supply of the control city, Muskegon (0.2 p.p.m.) remained unchanged until July 1951, when that city, impressed with the results of fluoridation in Grand Rapids, introduced fluoridation and thus ceased to be the "control" city. After ten years (1944-54) the dental caries rate of the younger children in Grand Rapids, who had consumed fluoridated water prior to dental development, had been reduced in the order of 60 per cent. The caries rate in Grand Rapids, after the ten years of fluoridation, was comparable to that of the children of Aurora (1.2 p.p.m. natural fluoride); whereas, the teeth of older children in Grand Rapids who ingested fluoridated water only in the latter years of their childhood showed less reduction in their dental caries (Arnold et al, 1956).

81. In New York State, the cities of Kingston and Newburg, each with a population of about 30,000 were selected for study. These two cities, some 35 miles apart, each had a practically fluoride-free water supply. The baseline dental and paediatric examinations were carried out before the study commenced and were repeated at yearly intervals. The pre-fluoridation survey showed that children, ages 6 to 12 years, in both cities had similar caries prevalence. In 1945 the fluoride content of the water supply of Newburg was increased to 1.0 - 1.2 p.p.m. The fluoride content of the Kingston water supply was not adjusted. After 10 years of fluoridation x-ray and clinical examinations were completed on 1,519 Newburg children between the ages of 6 and 14 and on 109 children aged 16 years. In Kingston 2,021 children aged 6 to 14 years and 119 aged 16 years were examined.

82. In 1945 the D.M.F. rate for the 6-to 9-year-old children in Newburg and in Kingston was similar. In 1954-55 the D.M.F. rate for the same age group was 58 per cent lower in Newburg children (the fluoride city) than in Kingston children. In this same group (6 to 9 year olds) 25.5 per cent of them in Newburg had all deciduous cuspids and molars present and caries free as compared with only 4.7 per cent in Kingston children, Schlesinger et al, (1950 and 1953), Ast and Schlesinger (1956), Ast et al (1956). The significance of this latter finding is in connection with proper mastication and therefore proper nutrition and the likelihood that

there would be a lower incidence of subsequent malocclusions.

83. The Grand Rapids-Muskegon and the Newburg-Kingston studies were paralleled at about the same time by a major study in Ontario, the Brantford-Sarnia-Stratford study. As mentioned in paragraph 76 the natural water supplies of the cities of Brantford and Sarnia contained practically no fluoride while the natural water supply of Stratford, since 1917, has contained 1.6 p.p.m. of fluoride. The Brantford fluoridation programme commenced in June, 1945, with the mechanical addition of fluoride to 1 p.p.m.

84. Evaluation of this study was based upon data compiled by the Department of National Health and Welfare, Brown (1951), Brown et al (1956). Experimental controls were established for Brantford through periodic examination of the children in Sarnia and Stratford. The data comparing the D.M.F. tooth count between 1948 and 1955 showed a marked and statistically significant reduction in the prevalence of dental caries among Brantford children toward levels observed among Stratford children of comparable ages. Children from Sarnia, the non-fluoride control city, exhibited the same order of high dental caries rates in 1955 as in 1948. These findings of Brown and his colleagues were corroborated by Hutton and his associates (1956) based on 12 annual surveys involving 56,347 dental examinations of Brantford school children. Mechanically fluoridated domestic waters (1.p.p.m.) produce a caries-inhibiting effect of about 60 per cent in the permanent and about 40 per cent in the primary dentition of the populations where teeth calcify after the introduction of fluoridation programmes. These findings have been corroborated in other Ontario areas, such as Oshawa and Sudbury (see Part VIII, paragraph 182).

85. These three separate investigations were planned and executed with great care. The data, we are convinced, have been analyzed with thoroughness and with integrity. We are familiar with the criticisms which have been leveled at the trials. We have perused with caution the publication of Sutton, "Fluoridation, Errors and Ommissions in Experimental Trials", Melbourne University Press, 1959, in which he attempted to refute the

validity of the findings of the major investigations. And in this connection the editor of the New Zealand Dental Journal, in introducing a review of Dr. Sutton's book by J. Ferris Fuller (January 1960) stated:

> "To those who are not as informed on the subject of fluoridation as they ought to be, Mr. Sutton's observations may sound plausible - so plausible in fact as to influence their better judgment regarding the proved merits of this anti-cariogenic measure."

Fuller, in commenting on Sutton's criticism of the Brantford-Sarnia-Stratford study says:

> " They accuse the Canadian workers of failing to devise a randomisation procedure that would eliminate bias, of deliberately omitting vital information in some of the tables, and finally of displaying bias in the presentation of results... Sutton and Amies failed to read two official publications readily available, namely a 51-page booklet, 'A Suggested Methodology for Fluoridation Surveys in Canada' and the 35-page detailed report of the Department of Health and Welfare, of November 1955. These two booklets together show that great care was taken to introduce a well-designed randomisation procedure, that examiner variability was eliminated as far as humanly possible by the employment of one examiner only throughout the whole period of the study, and that the information alleged to have been omitted is in fact shown in detail in the tables in the 1955 report, together with the standard error for each of the indices used. In short, the more important criticisms that appear so damaging are in fact without foundation..."

Fuller, commenting further on Sutton's additional criticism of other significant studies continues:

> "He [Sutton] doubts the accuracy of caries attack rates in test and control areas because x-ray examinations were incomplete or absent. It is

> significant that he [Sutton] omits to refer to a report by Hayes, McAnley and Arnold published in the U.S. Public Health Reports in December, 1956, which is the key reference in this subject ... The conclusion [of the above report] was that supplementary x-ray examinations supported the clinical findings and did not change the basic observation that substantial decreases in dental caries occurred during the test period."

86. Thus the major criticisms leveled by Sutton have been answered, not only by Fuller (1960) but as well by Galagan (1960), by Blaney (1960), by Dunning (1960), by Darling (1960) and by others. We have naturally taken note of these several articles which have appeared since the publication of Sutton's book, each of which in turn has shown that some of Sutton's criticisms were unjust and unfounded. Sutton, however, in some instances did sound a word of caution relative to statistical evaluations in general which undoubtedly will be heeded by epidemiologists.

87. The Committee, too, has considered many other criticisms of fluoridation studies. Broomfield, dealing with the New Zealand findings, and Ackerley, considering the data of Newark, Delaware, make capital of the fact that any dental survey made so far in a fluoridated area will include young children who have received fluoride from birth, which gives the most caries protection, and older children who have not received fluoride until after some or most of their permanent teeth have erupted, which provides the least caries protection. They turn these results around to suggest that fluoride only causes a delay in the development of dental caries, when in fact all these results show is that children with exposure to fluoride from birth have the greatest degree of caries protection.

88. Aware as we are of the data relative to the studies, of the criticisms, some justified and some unjustified, and of those things which might have been done in 1945 had the investigators known then what they knew in 1956, we are convinced, beyond any doubt, that artificial fluoridation of communal water supplies effects a significant and indeed a striking reduction in the incidence of

dental caries.

CHAPTER 6. Dental Fluorosis

89. Mention has already been made of the fact that the relation between fluoride and dental decay was demonstrated when the condition known as "mottled teeth" or fluorosis was found to be caused by the ingestion of water containing high concentrations of fluoride. Fluorosis is, in the definition of Dean (1954) an "endemic hypocalcification, or hypocalcification and hypoplasia of the enamel. The affection is largely limited to the permanent teeth, although in areas of medium to marked severity, deciduous teeth may be mildly affected." The large number of people exposed throughout life to a public water supply containing varying concentrations of fluoride, permitted dental fluorosis to be studied extensively from an epidemiological standpoint.

90. The early reports of field studies dealing with the epidemiology of fluorosed teeth commenced with the work of McKay (1916) who examined 6, 873 individuals in 26 communities and reported that the unknown causative factor of mottled enamel was present in domestic water used during the period of tooth calcification. Studies which confirmed this observation were made in many parts of the world and subsequent chemical analysis of water from areas where endemic mottling was present established the etiological agent of the mottling as fluoride. The relation between fluoride and dental fluorosis was further substantiated by the experimental production of dental lesions, similar to human fluorosed enamel, in white rats and in dogs, by waters from endemic fluorosis areas and waters to which fluoride had been added.

91. Direct clinical evidence that dental fluorosis could be inhibited first became available when two separate communities changed from water supplies containing excessive amounts of fluoride to supplies which were essentially free of fluorides, McKay (1933), Dean and McKay (1939). Thus Oakley, Idaho (6 p.p.m. of fluoride) and Bauxite, Arkansas (13.7 p.p.m. of fluoride) were the first communities to abandon an otherwise

satisfactory water supply solely for the purpose of preventing fluorosed teeth.

92. Extensive studies have been made by Dean (1933 through to 1942) from which the fluoride concentrations of water were correlated with the clinical severity of fluorosed teeth. Where the concentration of fluoride was relatively high, (over 4 p.p.m.) the degree of fluorosis was severe, and teeth showed signs of discrete or confluent pitting. In areas where the drinking water contained 2.5 to 3.0 p.p.m. of fluoride the affected teeth - and not all teeth by any means were affected - had a dull, chalky appearance and showed later a characteristic brown stain, which increased with age. In areas where the water supply contained 1 p.p.m. or less of fluoride there was no evident mottling of teeth.

93. A great deal of controversy has naturally arisen over the question of mottled teeth and the classification of fluorosis into "severe", "mild", "very mild", and "absent". One witness, Dr. Exner, was very outspoken not only in his criticism of Dean's work and interpretation but stated emphatically that fluorosis in itself is evidence of the harmful effects of fluoride. Subsequently, Exner testified:

> "There is, in my opinion, some reason to believe that some children will actually derive some measure of such benefit. However, there is no sound basis for the claims as to the amount of benefit that can be expected".

Mention should be made again of the fact (paragraph 91) that the cities of Oakley and Bauxite, with concentrations of 6 p.p.m. and 13.7 p.p.m. of fluoride in their water respectively, changed their water supply solely for the purpose of preventing mottled teeth and for no other reason. Following a careful and extensive survey of the literature relative to this question Elwell and Easlick of the University of Michigan (1960) state:

> "At approximately 1.0 p.p.m. less than 10 per cent of the children showed the least detectable evidence of disturbances in formation of the enamel; they were very mild disturbances not accompanied by staining,

> and were visible only to the trained eyes of an experienced dentist. At about 2.0 p.p.m. an increased proportion of children had mottled enamel that was apparent and objectionable esthetically. Maier has reported mild dental fluorosis as developing when concentrations of fluoride are above 1.5 p.p.m. Dean stated that while the safe level of fluoride concentration to afford a maximum caries preventive effect without mottled enamel is approximately 1.0 p.p.m., it varies somewhat with climatic and other factors and must be ascertained for each general area. Galagan stated that fluoride concentrations should be adjusted to climatic conditions. This adjustment for zones similar to the Great Lakes would require a concentration of 1.2 p.p.m. Galagan and Lamson have indicated that in hot dry climates, with a mean annual temperature of 70 degrees F. as little as 0.6 to 0.8 p.p.m. of fluoride in the water is considered equal in effectiveness to 1.2 p.p.m. in areas comparable to those surrounded by the Great Lakes."

94. At a symposium on fluoridation of public water supplies, the papers from which were published by Hine and Muhler as Editors (1959), the authors of one paper, Smith and Hodge, state:

> "The incidence of minor hyperplasia of the enamel is widespread in populations whose drinking water contains very low concentrations of fluoride (0.1 p.p.m. or less). For example, an incidence of 20 per cent of "white spots" was found in a survey of persons in Ohio drinking water which contained not more than 0.1 p.p.m. of fluoride".

To quote from the Report of the New Zealand Commission of Enquiry on Fluoridation of Public Water Supplies (1957):

> 'The mottled enamel frequently seen in New Zealand is due to unknown causes but certainly not to excessive intake of fluoride. Some 5 to 6 per cent of New Zealand children and young adults exhibited well marked idiopathic mottled enamel (Hewat, 1948); and Mr.

Ludwig found opaque enamel defects in 16 per cent of children at Napier and 11 per cent at Hastings".

When we recall that there are some 42 or more communities in Ontario with concentrations of 1.0 p.p.m. or more of fluoride in their drinking water and that 20 of those municipalities have a concentration of 1.5 p.p.m. or more and that 9 of them have 2.0 p.p.m. or more, and that not one brief nor one witness mentioned unsightly mottling of teeth in Ontario, we are inclined to agree with Dr. McHenry when he said, "I am sure from personal experience, that the teeth of children in Ontario in communities having water supplies containing 1.6 p.p.m. fluoride do not show mottling which is discernible to parents".

CHAPTER 7. Mechanism of Action of Fluoride in the Prevention of Dental Caries

95. Dental caries is a lesion of the hard tissues of the teeth. The initial process, as previously indicated, is considered to be a decalcification of the inorganic elements by organic acids produced by bacterial enzymatic action on carbohydrates. Proteolysis of the organic matrix follows the initial decalcification, Easlick (1948). Fluorides may, therefore, prevent caries in two ways. By entering the structure of enamel apatite the fluoride may render the enamel less soluble in the acids and/or the fluoride may inhibit bacterial glycolysis - the series of enzymic reactions leading to the production of organic acids.

96. The ingestion of fluoride in water at an optimal concentration results in the deposition of fluoride in the mineral phase of the tooth. The mineral phase has a crystal lattice structure which is common to a class of minerals known as hydroxyapatites. The important characteristics of the crystal relating to fluoride and mineral metabolism are firstly, that the apatite crystal is non-stoichiometric with respect to calcium and phosphate (in other words, more of these elements may be added to the crystal) and secondly, it (the apatite crystal) is capable of undergoing internal lattice substitutions (e.g. fluoride may substitute for an hydroxyl ion), and thirdly, the apatite crystal is ionic and capable of surface exchange and surface absorption.

97. In the deposition of fluoride in hard tissues during their development, the principal reaction, according to Newman (1950) involves a substitution of the fluoride for the hydroxyl group in the hydroxyapatite lattice. The fluorapatite thus formed markedly inhibits acid dissolution of dental tissue.

98. The maximum protection against dental caries, and presumably maximum deposition of fluoride, occurs primarily in those teeth that calcify during the period of ingestion of fluoridated water. Because teeth are continuously developing and erupting, with the exception of the wisdom teeth, until approximately age 15, this represents the period of time over which fluoride should be ingested. The fluoride present in food and drinking water is carried by the blood stream and is incorporated into tooth enamel during the process of calcification prior to eruption. After eruption of the teeth when they come into physical contact with fluoride-containing foods and water in the mouth, fluoride is added, to a much lesser degree than formerly, to the surface layers of enamel but not to the deeper parts.

99. The distribution of fluoride in the different parts of the tooth has been studied by several workers and since a great variety of foods contain fluoride (Appendix XI) it is to be expected that fluoride would be present in the teeth of all people. This is so. When, however, people consume water containing 1 p.p.m. of fluoride or more during that period when the teeth are forming and erupting the fluoride content of the teeth is considerably higher than it is when the fluoride content of the water is low. It is reasonable to assume that fluorapatite enamel is harder and more resistant to the organic acids in the mouth than is the hydroxyapatite. Experimentally it has been shown by Finn and DeMarco (1956) that enamel taken from deciduous teeth of children who had consumed fluoridated water from birth was less soluble in acid than the enamel taken from the teeth of children who had taken fluoride-free water from birth. And Isaac et al (1958) have shown that there is an inverse ratio between the fluoride content of tooth enamel and the degree of its solution in acids.

100. Numerous studies have been carried out to determine the inhibitory effect of fluoride compounds on bacterial enzymic reactions. It has been reported that concentrations of fluoride as low as 1 to 2 p.p.m. in saliva have a detectable inhibitory effect on acid production, and that 5 and 10 p.p.m. have a marked effect at pH values of about 5 (neutral is pH 7; 5 is acid). However, fluoride concentrations sufficient to interfere with acid formation were not reached in the saliva when fluoridated water (1 p.p.m. of fluoride) was ingested, Volker and Bibby (1941), Bibby (1944).

101. There seems to be no major differences of opinion as to the mechanism of action of fluoride in the prevention of dental caries, nor in the fact that the greatest degree of protection against dental caries is to be obtained when sufficient fluoride is ingested throughout the whole period of calcification of the teeth and continues to be ingested in an amount which will increase the fluoride content of the surface enamel of the teeth after they have erupted.

CHAPTER 8. Conclusions

102. i We accept, as fact, that fluoride ions naturally occurring in water are derived from the solution of mineral salts and that when such compounds dissolve in water, at low concentration (0.05 to 12 p.p.m. or even more) the fluoride ion passes into solution and remains as a fluoride ion regardless of the salt from which it originated.

ii We accept as fact also that it is impossible to distinguish between fluoride occurring naturally in water and fluoride added to a water supply.

iii We are convinced that the relevant studies are epidemiologically sound and conclusively prove that the presence of fluoride, either naturally occurring or mechanically added, in a municipal or communal water supply in concentrations of approximately 1 p.p.m. strikingly reduces the incidence of dental caries when such water is consumed during the period

of tooth development and that the caries-reducing effect of fluoride extends into adult life.

iv We recognize that very mild dental fluorosis is present in up to 20 per cent of the population living in areas with minimal amounts or no fluoride in the water but there is no fluorosis of esthetic significance specifically associated with a water fluoride concentration of approximately 1.0 to 1.6 p.p.m.

PART IV

TRACE ELEMENTS

CHAPTER 1. The Role of Trace Elements in Nutrition

103. When the scientists and other experts speak of something as being in a concentration of 1 part per million they speak about extremely minute amounts of the substance. And it is in this realm of minute amounts that trace elements as essentials in nutrition are considered. Dr. McHenry has advised us that in nutrition the following elements are considered to be trace elements - the term means that they may be present in foods in minute amounts and active in the body in similar minute quantities - iodine, fluorine, cobalt, copper, zinc, manganese. The number of elements included in this category varies to some extent, depending on the viewpoint of the author. Sir Joseph Barcroft defined the term, trace element, in the following manner:

i A trace element is usually a metallic element although iodine and fluorine could not be considered to be metallic;

ii It is a normal constituent of plant and animal tissues;

iii There is a healthful intake and both too little and too much may be harmful;

iv Nutrients would not be classed as trace elements unless the average amount in tissues was less than 1 part in 20,000;

v The action of a trace element is similar to that of an enzyme.

Using Barcroft's concept of quantity iron would be classed as a trace element but Dr. McHenry states that it is not customary to do so.

104. Just as there has been no proof that iodine in iodized salt can be distinguished by taste, smell, or appearance, so too has there been no evidence that humans can distinguish the presence of up to at least 2 parts per million of fluoride in water by taste, smell, or appearance. The presence of appreciable amounts of chlorine in water can be distinguished by taste and by smell.

105. The following elements are, according to the National Research Council (U.S.A.) 1958, required by humans to maintain a good nutritional status: calcium, chlorine, cobalt, copper, fluorine, iodine, iron, magnesium, manganese, molybdenum, phosphorus, potassium, sodium, sulphur, zinc and bromine. Many other elements are present in food and water, some in "trace" amounts but their presence is often incidental or dependent on soil, mineral, vegetative or water conditions locally. Most of these latter ones apparently play no part in human nutrition (arsenic, lead, selenium, aluminum, antimony, silicon, barium, rubidium, nickel, boron, chromium, gallium, strontium, tungsten, silver, thallium, mercury, cesium, vanadium, and uranium). The importance of carbon, hydrogen, oxygen, and nitrogen as components of most molecules of "food stuffs" is self evident. Any of these elements, or compounds containing them, whether the particular substance is essential for human nutrition or not, may be expected to produce deleterious effects if administered to animals or to humans in large amounts. This is, of course, true of any substance - even water itself, above a certain dosage level, becomes toxic. This level varies from substance to substance and with the method and rate of administration. Consequently, no one can draw a clear-cut line defining which substances, or elements, are beneficial and which are toxic. It is a question of amount and method of administration.

106. Unfortunately, because it should not be so, it is necessary to draw attention to these facts and to attempt, at least, to allay the fears of some opponents to fluoridation who claim that fluorides are "poison", "rat poison", etc. It is, if sufficient quantities are ingested. That it may be of interest, we list some of the elements essential to good nutrition and to indicate some of the uses to which those same elements are put when used in large quantities:

calcium oxide - Bordeaux mixture for killing insects
calcium arsenate - an insecticide
chlorine (elemental) - bactericide, fungicide
chlorine hypochlorite - preservative
chlorine in organic compounds - bactericide
copper sulphate - anti-protozoal
copper sulphate - viricide
copper sulphate - fungicides
copper in organic salts - insecticides
- vericides
- parasiticides
iodine (elemental - bactericide
- disinfectant
iodine - organic compounds - disinfectant
potassium iodide - fungicide
fluorine - sodium fluoride - insecticide
- rodenticides
phosphorus (yellow) - rodenticides
potassium - salts with above elements
sodium - salts with above elements
sulphur - calcium polysulphides - fungicides
- dioxide - bacterial inhibitor
- bleach
zinc - phosphide - rodenticide
bromium (bromioform) - disinfectant
- anti-bacterial

It may be added, too, that the body requirement for phosphorus, as determined in laboratory animals, is 18 mg. per kilo of body weight per day. The acute toxicity of phosphorus is 100 mg. per kilo - which is less than 6 times the daily requirement. On the other hand, the acute toxicity of fluoride is 200 mg. per kilo of body weight.

107. The Ontario Dental Association in its brief stated:

> "In trace amounts recommended for public water supplies the function of fluorides is to promote the development of teeth more resistant to tooth decay than would develop in the absence of fluorides. Fluorides thus may be included with sodium, copper, cobalt, or zinc as an essential trace

element in human nutrition".

Dr. McHenry, however, claims that this element is not considered to be an essential nutrient by workers in the field of nutrition - unless one wishes to conclude that fluoride is essential for humans because of protection against dental caries. There is no evidence that humans need fluoride for the maintenance of life. In this respect fluoride differs from iodine, which is a nutrient with an essential and established function. Dr. McHenry's approach differs widely from that of Dr. Brusch, who, in the course of his evidence, was more emphatic when he said:

> "We need carbon, hydrogen, oxygen, to build the body. The inert ones like silver are in our foods or in the soil. Then we have the destructive ones, such as arsenic and lead and fluorides because they interfere with the body functions. They can never be a nutritional element".

Finally, McHenry stated:

> "We don't know whether it (fluorine) is essential or not for humans because ... humans have not been maintained on a diet completely devoid of fluorine".

CHAPTER 2. Toxicity of Trace Elements

108. In any discussion or consideration of toxic effects of any chemic substance, trace elements, or nutrients in food, it is essential that the amounts or concentration of the substances be stated and constantly borne in mind. Otherwise the discussion becomes completely irrelevant to the question.

109. It is an accepted and established scientific fact that optimal intakes of many substances exist. When these limits are exceeded deleterious effects occur. If the intake is sub-optimal deleterious effects may also occur. The optimal level varies from substance to substance and with the rate and method of administration. Fluoride, in common with all other elements

or compounds of elements, including chemically pure water, produces deleterious effects on living organisms when it is administered or taken in relatively large amounts.

110. If the meaning of the word "toxic" is broadened to mean harmful or prejudicial to health, the presence of oxalic acid in rhubard, spinach, and other vegetables, and the presence of phytic acids in grains and grain products would be included. Oxalic acid and phytic acid impair the absorption of calcium and of iron and the use of foods containing considerable phytic acid has been claimed to cause rickets. One such food, as Dr. McHenry points out, is oatmeal, which is otherwise highly regarded. Likewise excess intakes of vitamin A and vitamin D, essential to the human body in optimal amounts, produce harmful effects.

111. Thus Dr. Exner's statement that "the soluble fluorides are deadly poisons" is absolutely true if the amounts of fluorides consumed are large enough. The same is true, as mentioned above, of many other elements and substances which in optimal amounts are requisite for the healthy body. The toxic effects of considerable amounts of fluoride have been known for many years and have been studied extensively. In humans, so-called acute fluorosis has been produced mostly by inhalation of finely ground fluorides in industrial operations. Acute fluorosis has also been reported as occurring in farm animals as a result of their ingesting finely ground rock phosphate, containing appreciable fluorides, when used as a fertilizer.

112. The first sign of fluorosis is usually the development of mottled teeth in young animals. The teeth have white patches and a rough surface. In adult animals the first effect is the development of changes in the bones. The surfaces of the long bones and lower jaw become thickened and densely calcified, sometimes with bony outgrowths. In humans fluorosis produces much the same picture. Mottling takes place. There is a loss of appetite and an increased density of the bones of the spine, pelvis, and limbs. The ligaments of the spine become calcified, producing "stiff" or "poker" back. These effects are produced by the ingestion of large amounts of fluorides over long periods of

time. But there is no evidence that any of these changes are produced by sustained ingestion of small quantities of fluorides even for periods of forty or more years.

113. Dr. E. A. Sellers and A. V. Marton have reviewed for the Committee the situation relative to the elements or chemicals found naturally in food or water which may reach toxic or near toxic concentrations, as follows:

> "The wholesomeness of water depends on its relative freedom from bacteria or other contaminants and on the presence in it of naturally occurring minerals or other elements. There is general agreement that contaminated water, whether this be of a bacterial nature or from other contamination, is not desirable or satisfactory as a public or private drinking water supply. There is also general agreement that high concentrations of minerals or other elements render water undesirable, and more or less arbitrary concentrations of various substances have been set as permissible or desirable. The criteria for deciding what concentration of a particular element is permissible or desirable, have varied considerably. Taste, odour, washing properties and properties in cooking, as well as prejudice to good health are the common criteria. In many localities of the world, water supplies in adequate amounts are not available which meet recommended standards. In many places such water has been used for many years with no apparent deleterious results. In most cases taste, or mild aperient action, are the obvious criticisms of such waters.
>
> "In Ontario there are municipalities which use water which exceeds the desirable limits of mineral content. An excerpt from a communication from the Ontario Water Resources Commission follows:
>
> " 'It is quite true that in many instances, municipalities do use waters that exceed allowable limits in some constituents. In some cases, because of the fact that alternative supplies are not available, these excesses

over the desirable tolerance are quite high.

" 'The generally recognized tolerance as far as fluoride is concerned is 1.0 to 1.5 p.p.m., yet we have a few municipalities that are above that limit. I can site Brussels 2.2, Hagersville 2.2, Lucknow 2.0, Ripley 2.4 and Zurich 2.0. I have never heard of any adverse conditions caused by these high fluoride contents. There are a few municipalities that have waters with iron contents that are above the desirable 0.3 p.p.m. Capreol, as an example, has 2.2 p.p.m.; Aurora, Newmarket, and Richmond Hill all have iron contents in the range of 0.8 p.p.m. The water is objectionable on some occasions because of this factor but it is still used by the citizens.

" 'There are municipalities in south-western Ontario where chlorides are very high. I can cite Comber where the content is 1200 p.p.m., Brigden 600 p.p.m., and Courtright 450 p.p.m. This water is still used because no other is available. The Town of Walkerton has a water that has a hardness of 1400 p.p.m. and the Village of Caledonia, a similar supply. This is above desirable limits but as no other water is available, they continue to be used.'

"Other provinces in Canada and districts throughout the world have similar problems and contend with them in the same way.

"In natural foodstuffs some elements or minerals occur in amounts which would be considered undesirable if the substance was present as a contaminant. An example is arsenic. In sea-fish and shell fish, arsenic is often present in considerable quantities.

	Maximum reported
Prawns	170 p.p.m.
Mussels	120 p.p.m.
Oysters	10 p.p.m.
Lobsters	70 p.p.m.
Plaice	4 p.p.m.

"For reference purposes, one dose of 1.3 mg. is alleged to have produced toxic symptoms; 6 mg. daily for 3 weeks has produced paralysis. (M.L.D. 0.8-2.4 mg./kg.). The general view is that arsenic should not be present in food or water as a contaminant. Nevertheless small amounts do occur. Amounts such as the above are considered above permissible limits as contaminants in food (3.57 p.p.m., U.S. Food and Drug Administration [as As_2O_3]); 1.06 p.p.m. (as As.), Council on Foods, American Medical Association.

"Selenium - occurs naturally in some soils, and in some vegetables, especially cereals. Limit of toxicity to animals and probably to men of selenium in food is placed at about 3 - 4 p.p.m., Munsell et al (1936). This is exceeded in grain in certain districts. Therefore animals eating a cereal diet may show signs of toxicity ("alkali disease" or "blind staggers"). Humans eating a mixed diet are not so likely to do so. The element is associated with the gluten particularly. North Dakota wheat, 1.1 - 18.8 p.p.m., other grains, 1 - 14.9

"Zinc - Permissible limit in water usually taken as 5 p.p.m. Some supplies contain up to 50 p.p.m. In some foods appreciable amounts of zinc occur naturally. Over 50 p.p.m. - wheat germ (140), wheat bran (75-140), beef liver (30-85), oysters (270-600)."

114. It is imperative, from the above, to recognize that many chemical substances, elements and even nutrients in food may be not only beneficial, but actually essential to the body in small amounts, and that the same chemical substances, elements and nutrients when ingested in excess may be harmful or even toxic to the body.

PART V

THE ACTION OF FLUORIDE IN THE BODY

115. In order that adequate consideration may be given to the question of the possible harmful effects or the chronic effects of fluoride ingestion a brief review of the physiological and pharmacological effects of fluoride is in order. Fluorides, the salts of fluorine, are readily absorbed from the gut and are distributed widely in the body in much the same way as chlorides, e.g. sodium chloride.

116. Acute poisoning, as used here, means the ingestion of a large amount of fluoride over a short period of time. In this connection, and based on 130 human cases of acute poisoning from fluorides reported by Roholm (1937) and by Cox et al (1951), it may be estimated that a retained dose of 4 to 10 grams (4000 to 10,000 mg.) of sodium fluoride will be lethal. The symptoms described are generally nausea, vomiting, and diarrhoea in the first instance. Later a shock-like state develops and the victims die between 2 and 4 hours after consuming these massive doses of the fluoride.

117. Two scientists, one in 1867 and the other in 1899, carried out self-recorded experiments on the toxic action of sodium fluoride. Rabuteau (1867) after collecting data from various animal experiments ingested 4,500 p.p.m. fluoride (250 mg. of sodium fluoride in 25 c.c. of water) and experienced slight nausea and epigastric distress for about 5 hours, excessive salivation for a few minutes and an itching sensation in his hands and feet for 7 days. Baldwin (1899) consumed first small amounts of sodium fluoride then took the same amount as ingested by Rabuteau. He reported nausea, excessive salivation and some retching as symptoms.

118. If one quart of water were consumed in a day, and this is a reasonable assumption for the average intake of an adult human in Ontario, about 120 p.p.m. of fluoride would have to be present to produce symptoms of acute poisoning. In other words, 120

quarts of water containing 1 p.p.m. of fluoride would have to be consumed by the one individual to obtain the same amount of fluoride. We are certain that the consumption of 30 imperial gallons of water by one person in one day is impossibly high and that, therefore, the high amount of fluoride necessary to produce acute poisoning, not lethal, could not be received as a result of consumption of fluoridated water.

119. A great deal of experimental work has been carried out in the study of the pharmacological and physiological effects of fluorides. One of these carried out by McClendon (1959) using trace amounts of fluorides, concentrations up to 10 p.p.m., in the drinking water of rats concluded that:

i fluoride is beneficial in traces, but toxic in higher concentrations,

ii there is an inverse ratio of dental caries and dietary fluoride,

iii skeletal fluoride is tightly held,

iv skeletal calcium fixes, and thus detoxifies, overdoses of fluoride.

The most recent studies conducted by the National Institute of Dental Research (U.S.A.) to determine whether pathological changes could be correlated with prolonged ingestion of fluoride-bearing water, disclosed no pathological condition that could be attributed to fluoride ingestion.

120. Microscopic and chemical studies of bones have been carried out and comparisons made between those persons who had lived in high fluoride areas and those who had lived in areas where the water supply was less than 0.5 p.p.m. of fluoride for ten years or more. The consumption of higher amounts of fluoride than 4 p.p.m. in drinking water resulted in fluoride-osteosclerosis (4.4 to 12.0 p.p.m. fluoride) or a high incidence of mottled enamel and chronic skeletal disease (5.9 - 6.3 p.p.m. fluoride). In Bartlett, Texas, where the drinking water contained 8 p.p.m. fluoride, 13 out of 114 lifelong residents showed some

osteosclerosis, Hodge (1956). Hypoplasia of the enamel (mottling) was reported by Hodge when the drinking water contained 2 to 5 p.p.m. or more of fluoride. He stated that dental fluorosis can only be produced during the first 8 years of life. Endemic dental fluorosis appears only when the fluoride content of the water supply is more than 2.0 p.p.m.

121. Bones and teeth normally contain small amounts of fluoride, 0.05 to 0.21 per cent fluoride being considered as normal in the bones of adults who do not consume increased amounts of fluoride. The amount of fluoride increases in skeletal tissues and in dental tissues in a regular fashion with age, Glock et al (1941) and Hodge (1956). There is a normal accumulation of skeletal fluoride with the consumption of a drinking water containing as little as 0.06 p.p.m. of fluoride, Smith et al (1953). The disposition of fluoride in bone is reversible although slow. The period required to mobilize and remove from the body one half of the bone fluoride is longer than a year. Between 25 and 50 per cent of ingested fluoride appears to be deposited in the bones, Hodge (1956). A comparison of the fluoride content of successive layers of tooth enamel revealed that a higher fluoride concentration existed in the enamel surface than in the inner layers. An increase in the fluoride content of the drinking water resulted in an increase of fluoride deposited in the enamel. There was an increase of the outer as well as the inner enamel with age when the fluoride of the water was between 0.1 and 1.0 p.p.m., Isaac et al (1958).

122. The urinary excretion of fluoride is rapid and selective. The rapidity of the excretion is attributed to a somewhat lower resorption of fluoride (than for chloride) in the kidney tubule, Chen et al (1955), Hodge (1956). There is a special mechanism for the fluoride excretion in the urine. Fluoride in small amounts is a normal constituent of human urine. A significant part of ingested fluoride is promptly excreted. A variable percentage (between 50 and 66) of the fluoride intake appears in the urine and it is assumed that the daily urinary excretion is a great fraction of the intake when human beings consume trace amounts of fluoride, such as 1 p.p.m., over a period of years, Hodge (1956). Children store a considerable fraction of the ingested fluoride and this fraction decreases with increasing age, Gdalla (1958).

123. Studies with radioactive fluoride (F^{18}) indicate that the excretion of fluorides through saliva is of minor importance, Wills (1940). The amount of fluoride in the saliva has no correlation with the fluoride content of the water supply up to 1.8 p.p.m. Sweating, on the other hand, may account for an appreciable loss of fluoride from the body, McClure, (1946) and Machle and Largent (1943).

124. When the amount of fluoride in the drinking water is 0.1 p.p.m. or less, the blood level is about 1 microgram per hundred millilitres of blood. The blood level reflects to some extent the daily intake of fluoride. In Newburg, New York, where the water supply contains 1.1 p.p.m. of fluoride, the average blood level was 4 micrograms per hundred millilitres of blood, Hodge (1956). Smith et al (1950) previously had shown that an increase of 23 times in the fluoride concentration of drinking water produced a 3-fold increase of blood fluoride level.

125. The amount of fluoride in the placenta is small. Only at high levels, in excess of 10 p.p.m. fluoride, is there any indication of mammary gland transfer. The amount in mammary gland secretion is very low.

PART VI

EFFECTS OF PROLONGED EXPOSURE TO FLUORIDE

CHAPTER 1. General

126. A considerable volume of evidence was recorded during the hearings of the Committee relative to the epidemiological and statistical evidence concerning the possible harmful effects of water-borne fluoride upon non-dental organs and processes in the body. The review of this evidence by Dr. Buck is particularly pertinent. The concentration of fluoride occurring naturally in water supplies in various geographical locations and any proven differences in the morbidity, mortality or other features of health or disease of the people in the various areas relative to the concentration of fluoride and the epidemiological, statistical or other controlled surveys which have been undertaken to prove or disprove that fluorides in various concentrations have an influence on non-dental organs or processes, are intimately related. In discussing these points intelligently it is necessary to deal at the outset with the underlying issue which gives them their importance. The object is to determine, on the basis of evidence, the safety or otherwise of adding fluoride in a concentration of 1 part per million to public water supplies. With this aim in mind it is possible to adopt some criteria by which to assess the available data.

127. As Dr. Buck said:

> "With only a little reflection, it becomes clear that one could not have evidence sufficient to state that fluoridated water would never, in any individual, produce an adverse systemic effect. This situation is not peculiar to the fluoridation problem, since we cannot state with certainty that <u>any</u> event is impossible. Thus, all that one can reasonably demand is evidence that the likelihood of ill-effects from the long-term ingestion of fluoride at this concentration is small. To put this more specifically, as it applies to the evaluation of our present knowledge about the chronic systemic effects of fluoride, we should set up the following medical criteria for establishing the safety of fluoridation:

> (1) That all the likely specific ill-effects of chronic exposure to fluoride have been considered; (2) that investigations have failed to provide any evidence that these ill-effects follow the long-term ingestion of water containing fluoride at specific concentrations; (3) that the investigations have been adequate in terms of experimental design, and based upon a sufficient volume of data that they would have permitted the detection of the ill-effects postulated".

In the second of Dr. Buck's criteria, the term "at specific concentrations" must be clarified. She continues:

> "Although the accepted concentration for artificial fluoridation is 1 p.p.m., it would be prudent to search for ill-effects at concentrations somewhat higher than this, since in any population group exposed to 1 p.p.m., there may be some individuals receiving, in effect, a higher amount either because of an above-average consumption of water or because of a reduced excretion of fluoride".

128. Information about the possible consequences of long-term exposure relative to high concentrations of fluoride in man comes mainly from two sources: (1) Studies of workers with industrial exposure to high concentrations of fluoride and (2) clinical reports of patients from India, China, and Africa where, in some areas, water supplies have a particularly high concentration of fluoride. The most complete description of the effects of prolonged industrial exposure is that of Roholm, based upon observations of workers in the Danish cryolite industry who, over a period of 10 to 20 years, had a daily intake of 25 - 30 mg. of fluoride. Since this daily intake is approximately 20 times that which would be received by consuming water containing 1 p.p.m., the medical data recorded for the cryolite workers should represent the fullest range of the possible harmful consequences of fluoride exposure which need be considered. Roholm's reports indicate that the non-dental pathological effects of such high doses of fluoride are confined to the musculo-skeletal system. The typical clinical picture among cryolite workers was one of osteosclerosis, with stiffening of the joints, exostoses and calcification of the ligaments. This pathological process has been termed "skeletal fluorosis".

In another study of cryolite workers macrocytic anaemia was found in a proportion of the workers afflicted with skeletal fluorosis and was believed to be a consequence of the bone pathology, Moller and Gudjonsson (1932). It should be recalled again that the daily intake of the cryolite workers was about 25 - 30 mg. of fluoride.

129. Clinical observations from parts of India, North Africa, and China with naturally occurring high levels of fluoride in the water supply have been well summarized by Cox and Hodge (1950), and by McClure (1946). Here again, the pathology appears to be confined to osseous tissue. These clinical observations are sometimes improperly regarded as investigations of the effects of specific doses of fluoride. The actual amount of fluoride among the patients was rarely known. The reports deal only with afflicted persons and therefore provide no measure of the frequency of ill-effects among the population of the region nor of the role of hot climate and of malnutrition in contributing to the pathological process. For these reasons, such reports can only be used to indicate what the most severe medical effects of chronic fluoride ingestion might be.

130. Many observations in animals have been made in relation to the possible harmful consequences to man of prolonged fluoride consumption. McClure (1946) has discussed this whole topic and feels that there is some evidence that massive doses of fluoride can produce kidney damage in animals. However, since we are dealing with trace amounts (1 p.p.m. of fluoride in water) this finding is more of interest than of relevancy. On the basis of the above evidence it appears to us that the main medical complication of prolonged exposure to fluoride is that of skeletal fluorosis and with the possibility of renal damage. Our attention should be focused on these two major points when we examine from a clinical and pathological point of view reports of clinical studies where the fluoride consumption in drinking water has been far below those producing skeletal fluorosis. Indeed as Dr. Buck states:

> "To go beyond this and to look for other effects is desirable, but it should be borne in mind that no a priori reason exists for seeking other pathological

consequence of fluoride consumption".

CHAPTER 2. Is Fluoride Harmful? - Medical Evidence

131. Although there are hundreds of papers in the literature which deal with the medical effects of ingestion of fluoride in water, most of which have either been read by the members of the Committee or reviewed for them, only a few studies which appear particularly relevant and scientifically adequate will be discussed. McCauley and McClure's study (1954) of the effect of fluoride in water upon the skeletal development in children is one in point. This investigation was carried out in three cities in the United States. Two of the cities, Amarillo and Lubbock in Texas, are the largest communities in the country with at least 3.5 p.p.m. of naturally occurring fluoride in the public water supply. Amarillo's fluoride ranged from 3.3 to 6.2 p.p.m. and Lubbock's from 3.5 to 4.5 p.p.m. The control city was Cumberland in Maryland where the water supply contains 0.12 p.p.m. of fluoride. A total of 2,050 children between the ages of 7 and 14 years was examined, with approximately 700 from each city. The children were selected from school records on the basis of their residence history; thus all of the children in the study had been in continuous residence in the one city.

132. The investigator's hypothesis was that any effect of fluoride would be in the direction of hyper-calcification of bone and advanced skeletal maturity. From an x-ray film of the right hand and wrist, a carpal ossification ratio* and the skeletal age rating were calculated for each child. The "means" of these values for the three cities were presented on an age and sex-specific basis. A comparison was made also of dental fluorosis and the degree of skeletal change. Taking together all the results of this carefully controlled study there was no consistent relation between skeletal development and fluoride content of the water. The skeletal age ratings were not even consistently related to the presence or absence of dental fluorosis. In fact, among Lubbock (3.5 to 4.5 p.p.m. fluoride) and Amarillo (3.3 to 6.2 p.p.m. fluoride) boys at age 14, with a maximum period of exposure to fluoride, the skeletal age was actually

somewhat lower in the children with the dental mottling!

> * The carpal bones are a particularly good index of skeletal development. The many studies of these bones which have been made in normal children of different ages, have shown that their ossification proceeds in a definite and uniform manner. Thus a reliable standard of normality is readily available for the development of this part of the skeleton. Careful studies of the bones of the hand, foot, elbow, knee, shoulder and hip have indicated that examination of the hand gives the most reliable single index of skeletal maturity.

133. Other studies by McClure (1946) represent attempts to search for the most likely harmful effects of long-term ingestion of fluoride and his findings in relation to the effects of fluoride in water upon bone fracture experience, height, body weight, and renal function (kidney) are as important as they are relevant.

134. The study of bone fracture experience showed that among the boys whose community water supplies varied in fluoride concentration from 0.0 to 1.9 p.p.m., the lifetime frequency of total fractures varied from 20 to 30 fractures per 100 boys in a manner completely unrelated to the fluoride content of the water. A similar result was obtained for the young adults over a fluoridation range of 0.0 to between 3.8 and 5.1 p.p.m. When fractures of individual bones were considered, the results were the same as for total fracture experience.

135. Studies in height and weight were made among 1,450 high school boys who participated in the above fracture investigation. Variations in mean heights and weights for boys in the different cities were small and showed no relationship to water fluoride content.

136. McClure's study of renal effects was based upon urine tests for albumen, glucose and occult blood in 101 young men from the West Texas Panhandle, where the water fluoride ranged

from 2.0 to 5.2 p.p.m., and in 394 young men from non-fluoride areas. Occult blood was found in none of the specimens from the control areas and in 1 specimen from the Texas group. Albumen was found in 4 per cent and in 6 per cent of the specimens from the fluoride and control areas respectively. Glucose was found in 2 per cent of the fluoride area specimens and in 5 per cent of the control area specimens. These indications of impaired renal function offered no evidence that renal damage in young men might result from the consumption of water containing fluoride in excess of 2 p.p.m.

137. Autopsy studies of the fluoride content and histological appearance of bone in relation to water fluoride have been conducted by Zipkin et al (1958) and Geever et al (1958) on persons dying from various causes who had at least 10 years of exposure to water fluoride in concentrations ranging from 0.1 to 4 p.p.m. In Zipkin's study a linear relationship was found between bone fluoride content and the fluoride concentration of the water in the area from which the subject came. In Geever's study 37 autopsied subjects (27 of them having been exposed for at least 10 years to water containing 2.6 p.p.m. fluoride) were compared with 33 control cadavers from areas with less than 0.5 p.p.m. of fluoride in the water supply. Detailed microscopic examination of bone specimens and lumbar intervertebral joints were carried out in each group of subjects. No differences between the groups were found in the frequency of periosteal changes. The average thickness of compact bone was slightly less in the fluoride series, although the difference was not statistically significant. The average thickness of spongy bone was almost identical in both groups. On the basis of these findings, it is evident that the classical picture of osteosclerosis and stiff joints was not observed in these subjects who had been exposed for at least 10 years to an average water fluoride concentration of 2.6 p.p.m.

138. Mention should be made of the general medical survey of the residents of Bartlett, Texas, with a natural water fluoride content of 8 p.p.m. and of Cameron, Texas, with a water content of 0.4 p.p.m., as conducted by Leone et al (1954). A random sample was taken from each city in 1943 of persons who had lived in that city continuously for at least 15 years. That year and

again in 1953 all the subjects were given complete medical and dental examinations with x-rays, blood and urine studies. The details of this well-known study are, for this report, not essential. The one statistically significant clinical difference which was encountered was the greater frequency of cardio-vascular disease in the Cameron subjects, low fluoride area. No statistically significant differences in incidence over the 10-year period were observed for the following abnormal conditions: arthritis, hypertension, various abnormal bone changes, cataract, thyroid disease, deafness, tumours and cysts, fractures, urinary and biliary calculi. The results of this particular investigation, for a number of reasons, are somewhat difficult to assess and consequently have given rise to considerable controversy. However, they provide no evidence that clinically significant bone damage or other diseases follow the consumption of water containing 8 p.p.m. of fluoride.

139. Statements have been made that death from heart disease, cancer and other specific causes is higher in high fluoride areas than in low fluoride areas. The study of this question by Hagan, Pasternack and Scholz (1954) is based on death rates during the period 1949 to 1950 in 64 cities scattered widely over the United States. The cities were grouped in 32 pairs - one city, with naturally occurring water fluoride of 0.7 p.p.m. or more and an adjacent city with less than 0.25 p.p.m. of fluoride. Mortality rates were calculated for all causes and for heart disease, cancer, intracranial lesions of vascular origin, nephritis and cirrhosis of the liver. All rates, naturally, were adjusted for population differences in age, race, and sex. The total population upon which these rates are based was approximately 4 million person-years. In presenting the data the authors indicate the range of fluoride concentration for the "fluoride" city in each pair. Statistically significant differences were found neither for total mortality nor for the five specific causes of death. There is no evidence from this study that mortality from nephritis is elevated in populations exposed to concentrations of water fluoride over a range of 0.7 to 4 p.p.m. Further, it provides no evidence that three leading causes of mortality (heart disease, cancer and intracranial vascular lesions) are in any way related to water fluoride concentration over the range investigated.

140. The many and varied allegations that fluoride causes or accelerates the development of many, many disorders has reached the public through pamphlets, press releases and from time to time through the scientific literature. So many are the disease states which are attributed to fluoride ingestion, by those who are opposed to fluoridation, that it would appear to be the cause of almost every disease of non-bacterial origin. That these claims are as fantastic as they are unwarranted has been amply proven by controlled surveys and detailed studies.

141. On the other hand there are, we are sure, many people, indeed the vast majority, who are sincerely and honestly concerned about any possible ill-effects which might result from the consumption of fluoride-bearing water. Their apprehension is appreciated and we are sure that they are interested simply in knowing the truth.

142. The School of Public Health of the University of Michigan is a well-known and highly regarded academic and research entity within the equally high standing University of Michigan at Ann Arbor. Elwell and Easlick of that institution have brought together all of the relevant evidence in a recent publication (1960), "Classification and Appraisal of Objections to Fluoridation". This is a monumental work in its field. Its accuracy we accept. We can provide no better summary of the various subjects discussed than they have prepared:

i Objection: "Fluorides cause or accelerate the growth of cancer.

Appraisal: "There is no evidence that cancer of the breast in human beings relates to fluorides in drinking water.

"There is no evidence to indicate that the risk of death by cancer is increased by drinking fluoridated water.

"There is no evidence to conclude ... that lower rates for cancer are produced by the fluorides in the water".

ii Objection: "Fluoridated water causes conditions or diseases of the digestive tract which include (1) gastric or duodenal ulcers, (2) colitis, (3) failure of synthesis of vitamin B, (4) failure of absorption of vitamins B_1, B_2, B_6, and C, (5) nausea and vomiting, (6) diarrhoea, and (7) constipation".

Appraisal: " A comprehensive review of the literature on fluoridation reveals no evidence that any of the conditions or disorders [listed above] are caused by fluorides, used in concentrations recommended for communal supplies of water".

iii Objection: "Fluoridation causes disorders of the liver, such as cirrhosis, degeneration, or hepatitis".

Appraisal:"A search of the scientific literature reveals no evidence to indicate that drinking water which contains 1.0 to 1.5 p.p.m. of fluoride has any cumulative or harmful effect upon the liver. On the contrary, available scientific studies, some of which cover periods in excess of 10 years, have demonstrated conclusively that drinking water which contains about 1 p.p.m. of fluoride produces no systemic diseases or malfunctions".

iv Objection: "Fluoridated water interferes with normal enzymatic function".

Appraisal: "It is true that a high concentration of fluoride may inhibit certain enzymatic processes. However, there is no evidence that the ingestion of drinking water containing about 1 p.p.m. fluoride will produce a concentration of fluoride in any tissue of the body that will affect adversely the enzymatic systems of that tissue .

"There has been no demonstration that fluoride ions in a concentration of 1 p.p.m. in water will affect adversely any enzyme used in a fermentation or any other industrial process".

v Objection: "Fluorides cause or aggravate diseases or disorders of the kidneys, such as nephritis, nephrosis, renal insufficiency, and uremia".

Appraisal: "The body is capable of eliminating easily the small amounts that are ingested in drinking water which contains about 1 p.p.m. of fluoride. It has been stated by leading authorities on human nutrition that 'it is necessary to take into the system from 5 to 10 grams in one dose in order to cause fatal poisoning. Thus for any person to become poisoned from drinking fluoridated water at one part per million, that person would have to drink at least fifty bathtubs full of water. Long before, the person would die of water intoxication or drowning'.

"No evidence exists that water-borne fluoride has been a cause of nephritis.

"The study disclosed no evidence of any irritative effect on the kidneys".

vi Diseases of the Respiratory System: "It may be concluded from a detailed review of the literature that there is no evidence to indicate that fluorides in drinking waters are related in any way to diseases of the respiratory system".

vii Objection: "Fluorides are used in industry as hardening agents and therefore fluorides will cause hardening of the arteries".

Appraisal: "This conclusion has been based on a lack of understanding of the chemical, pharmacological and physiological actions of fluorides; these factors (of arteriosclerosis) were known prior to the practice of fluoridating water supplies and were found to be completely independent of fluoridation".

viii Objection: "Occurrence of varicose veins has been associated with endemic fluorosis".

Appraisal: "No specific aetiological factor has yet been established for varicose veins. Certainly there has been no evidence presented to substantiate a conclusion that fluoridated drinking water causes varicose veins".

ix Objection: "Fluorides cause hypertension".

Appraisal: "Hypertension is not a disease. It is only a physical sign which occurs as a common constituent of the syndrome of several diseases. However, the conditions known to contribute to the development of hypertension are not associated with fluorides".

x Objection: "Fluorides cause or aggravate heart disease" and "produce coronary thrombosis or heart failure".

Appraisal: "Scientific evidence from numerous surveys and studies has not revealed that water, fluoridated to proper concentrations for the areas concerned, provides any hazards to health".

xi Objection: "Fluorides cause hemophilia, anemia, produce leukaemia, cause abnormalities of leucocytes, retard formation of leucocytes, increase the clotting time of blood".

Appraisal: "Scientific evidence indicates that the continued intake of low concentrations of sodium fluoride, such as those ingested in drinking waters, leads to no detectable deleterious effects on the blood or on any other part of the body.

"It is logical to conclude that the ingestion of drinking water containing low concentrations of fluoride will not cause leukaemia inasmuch as significantly larger amounts taken for long periods have not produced the disease".

xii Objection: "The drinking of fluoridated water will produce disorders of the eyes such as (1) partial or complete loss of vision, (2) cataracts, (3) glaucoma, (4) detached retina, (5) conjunctivitis, and (6) color-blindness.

Appraisal: [Appreciating that several of the major studies included special ophthalmological examinations] - "No clinically significant physiological or functional

effects resulted from prolonged ingestion of water containing excessive amounts of fluoride (8 p.p.m.) except dental fluorosis".

xiii Objection: "Fluorides in drinking water produce diabetes".

Appraisal: "Extensive studies concerning possible relationships between waterborne fluorides and diabetes have been reported.

"These data show a complete lack of correlation in rates of death for diabetes between cities whose water varied as much as 0.5 and 2.5 p.p.m. of fluoride.

"Moreover, no evidence was found in a 10-year study at Sheboygan to indicate that fluorides had any adverse effects on people's health".

xiv Objection: "Fluorides cause impaired functioning or disease of the thyroid gland, the adrenals and the sex glands".

Appraisal: "Numerous scientific studies of fluorides have discussed medical findings with meticulous attention to detail and objectivity. It seems reasonable to conclude that no abnormal findings were discovered in relationship to adrenal, thyroid, or sexual glands. Furthermore, no evidence has been submitted to substantiate a belief that fluoridated water is harmful to these tissues".

143. The question has been raised, too, as to the alleged influence of fluoride on pregnancy. We have already mentioned that the amount of fluoride in the placenta is small. It has also been shown that the amount of amniotic fluid is in no way related to the fluoride content either of the placenta or of the mother's blood, and although the evidence does show that the ingestion of water containing approximately 1 p.p.m. of fluoride has no ill-effects on either the mother or the baby, at the same time, it does have a definitely beneficial effect in reducing the

incidence of dental caries.

144. It has been stated also that drinking fluoridated water produces various mental and neurological disturbances. Such conditions as neuroses, psychoses, stammering, neuritis, failing memory, nail-biting, multiple sclerosis and even poliomyelitis have been attributed to fluoride. Most, if not all, of these allegations cannot be traced or properly studied. We must, therefore, accept the results of the many carefully conducted examinations and studies reported in the literature by reliable persons and conclude that there is no acceptable evidence to support such contentions but that there is ample evidence of the value and the safety of fluoridation.

145. That not a little irresponsible thinking and writing has taken place relative to the effects of fluoride is contained in some statements made by Dr. Spira, as noted in the New Zealand "Report of the Commission of Inquiry on the Fluoridation of Public Water Supplies", 1957, paragraphs 324, 325, and 326. For example he stated:

> "A case of maculo-anaesthetic leprosy is recorded which was accompanied by the presence of 'mottled teeth'".

Thus arises his suggestion that chronic fluoride poisoning and leprosy may be identical! This, to us, as it was to the New Zealand Commission, is simply an example of the irresponsible speculations, subsequently translated into statements of fact, and which when repeated often enough by careless people set a trend of thought so difficult to refute.

146. It is the same Dr. Spira who expressed his views that fluoride has a harmful effect on the parathyroid glands. He wrote that "Fluorine is a nerve toxin, whose deleterious action consists in its ability to precipitate calcium salts stored in the body ... based on the fact that organs biologically originating in the ectoderm and regulated by the parathyroid glands, namely the skin and its appendages, the teeth, nails, and hair, are affected in chronic fluorine poisoning". Such so-called reasoning by men

like Dr. Spira is as unfounded as it is misleading to lay persons. It was he, too, who described so many signs and symptoms - about thirty ailments in all - of so-called fluoride poisoning, or chronic endemic fluorosis, that when brought together have been referred to as Spira's syndrome.

147. Dr. Waldbott, a respected allergist and a leader in the opposition to fluoridation holds certain views not completely dissimilar to those of Dr. Spira. Although Dr. Waldbott proved to be an interesting and indeed a revealing witness, much of the evidence which he submitted both in his brief and in his subsequent statements, cannot be admitted as scientific or as acceptable clinical evidence. In one of his publications he states:

> "The most characteristic manifestations [of insipient chronic fluoride poisoning] are backache, numbness and pain in the legs and arms, especially in the ulnar area, gastro-intestinal and bladder disturbances as well as ulcers in the mouth and visual disturbances. Most impressive are extreme malaise and mental sluggishness ... Arthritis, headaches, and seborrhoeic dermatitis may or may not be a feature of this disease".

148. It is very difficult for us to realize that Dr. Waldbott, who as an allergist is well-recognized and must be familiar with the use of scientific methods, would present "cases" which he uses to demonstrate the disappearance of "symptoms" following the withdrawal of fluoridated water and the return of the "symptoms" when fluoridated water was again ingested. Since Dr. Waldbott has not presented data, on a controlled study basis, showing that persons who drink water containing 1 p.p.m. of fluoride exhibit the symptoms which he claims are due to fluoride and that a "control" group does not exhibit such symptoms we find his evidence unconvincing and have come to the conclusion that the many signs and symptoms attributed by him to fluorides are not related to the ingestion of fluoride at about 1 p.p.m. in drinking water or food.

149. Although Rapaport (1956) claimed an association between the prevalence of mongolism and the concentration of fluoride in the drinking water, Berry (1958) in a study conducted in the United Kingdom specifically related to this problem concluded, "No indication emerges of any relationship between the level of fluoride in the water system and the incidence of mongolism ... The findings do not confirm those of Rapaport". Apparently Rapaport made an error in his statistics, being as he was, unfamiliar with the system of recording vital statistics in the United States.

CHAPTER 3. Limits of Water Consumption

150. The question of water consumption by an individual was raised by several witnesses and although we have already indicated that it would be impossible for a person drinking water containing approximately 1 p.p.m. of fluoride to consume enough water to produce any ill-effects as a result of the fluoride, it is necessary to consider Dr. Exner's statement that the daily consumption of 50 to 60 pints of water is not too uncommon. This level of water consumption might be found in the most severe case of an extremely rare disease known as diabetes insipidus, which is not to be confused with diabetes mellitus. We are of the opinion, however, that a daily consumption of 25 to 30 quarts of water is impossibly high for a normal person.

151. It is quite apparent that in warm weather, or during strenuous exercise, or while doing heavy work in a hot environment, water intake is increased. The maximum amount of this increase is stated by Wolf, in his new book "Thirst", Charles C. Thomas, Springfield, 1958, to be a six-fold augmentation of the average water intake. Under extreme conditions, then, an individual drinking water fluoridated to 1 p.p.m. could receive a daily amount 6 times that intended. But let us recall that the people living in Bartlett with an average consumption of water containing 8 p.p.m. of fluoride receive 8 times the recommended amount of fluoride. However, Bartlett, situated as it is in Texas, is in a warm region where during parts of the year it is quite possible that the water intake of some individuals may have been at least twice the average. These individuals, then, would

have had 16 times the intended or optimum amount of fluoride. Yet no clinically significant bone or other abnormalities were found in the Bartlett epidemiological study. We must conclude again, that a concentration of 1 p.p.m. of fluoride in the drinking water is eminently safe over a very wide range of water intake.

CHAPTER 4. Relation Between Fluorides and Periodontal Disease

152. The term periodontal disease includes abnormalities of the supporting structures of the teeth, the interrelationship and aetiology of which are often obscure, hence, as Grainger, Nikiforuk and Paynter pointed out to us, criteria for epidemiological investigations of periodontal disease are as yet inadequate. This situation has led, naturally, to a great deal of speculation in the literature as to the possible relations between fluoride and periodontal disease, although no real evidence that such a relation does exist has been brought to our attention.

153. The prevalence of periodontal disease in children is not nearly as high as in adults. Generally when attempts have been made to quantitate the disease epidemiologically in children, a simple measure of the degree of gingivitis has been taken as the criterion. This is not, as has been pointed out to us, necessarily a good measure of the true destructive process associated with "periodontal disease" but may to a large extent reflect the state of oral hygiene, which, if poor, is associated with a greater degree of gingivitis.

154. Brown and his associates (1954) reported on the incidence of gingivitis among the school children in Brantford, Sarnia and Stratford. They wished to ascertain, firstly, whether communal fluoridation had any influence on the prevalence of gingivitis in a community; and, secondly, whether the "P.M.A. index" which had been proposed by Schour and Massler (1949) as a measure of gingivitis was a satisfactory method of measuring the condition. At the time of this study, 1954, Brantford had been using fluoridated water for 8 years; Sarnia had a negligible amount of fluoride

in its water and Stratford had had a fluoride concentration of about 1.6 p.p.m. in its water for many years. The authors found that the incidence of gingivitis was similar, both in prevalence and in severity among the children in Brantford and Sarnia. In Stratford the percentage of children affected and the severity of the gingivitis were both greater than among the children in either of the other two cities. Brantford had the lowest prevalence of gingivitis (58 per cent) and the highest incidence of good oral hygiene (32 per cent). Stratford, however, had the highest percentage of children affected by gingivitis (79 per cent) and the lowest percentage of children with good oral hygiene (10 per cent)! "This," speculated the authors, "reflects a public carelessnes in respect to oral hygiene, attributable to low caries rate of long standing". If fluoride affected the gingiva adversely the Brantford children should have had more gingivitis than those in Sarnia because of the eight years of fluoride exposure of the former.

155. In the Kingston-Newburg studies, previously discussed, it was reported by Ast et al (1956), "It is of significance that the fluoride intake was not associated with an increased prevalence of gingival disease". Russel's study (1957) supports the hypothesis that the use of fluoride-bearing water does not injure the periodontal tissues. McClure (1945) in a short-term study of adults could find no relationship between fluoride ingestion and the state of the tissues in the oral cavity.

156. In a paper by Russell and Elvove (1951) reporting a study of the fluoride-dental caries relationship in an adult population, data are presented relating to fluoride and periodontal disease. The individuals studied lived all of their lives in either Colorado Springs (2.5 p.p.m. fluoride) or Boulder, Colorado (fluoride free). When tooth mortality rates had been adjusted for certain factors, the people of Boulder had lost 4 times as many teeth from periodontal disease as had those from Colorado Springs. Other studies have also been conducted on this question and so there is available a reasonable amount of data which makes it possible to state, contrary to Dr. Leslie's contention, that fluoride ingestion at optimal biological concentrations, or even higher, does not adversely affect the gingiva or supporting structures of the teeth.

157. The relation or influence of fluorides in malocclusion has likewise been raised. Grainger, Nikiforuk and Paynter have provided us with the following information:

> "The etiology of malocclusion is complex. It is known that faulty facial growth and development, injury, pernicious habits such as thumb-sucking, and inherited factors are each capable of seriously effecting the occlusion. There is also wide acceptance by practising dentists that premature loss of teeth (particularly deciduous molars), or extreme destruction of tooth crowns by dental caries are important causes of a particular type of malocclusion characterized by tooth crowding or misalignment. The crowding is presumed to come from the drifting of adjacent teeth into the region of the tooth (or tooth tissue) loss so that insufficient space is avialable for the eventual eruption of the permanent teeth. Prevention of this malocclusion is clinically possible by inserting a space-maintaining appliance immediately after the tooth loss or by reconstructing the mutilated teeth before space is lost".

158. Our specific interest in the problem of malocclusion rises through the possibility of reducing, even in a small way, its incidence through a reduction of dental caries in the deciduous teeth and reducing the subsequent premature loss of teeth. Because fluoridation reduces the dental caries attack rate and hence the dental treatment needs, it is to be expected that a tangible but perhaps smaller decrease in malocclusion would be noted in a population using fluoridated water. From the Evanston fluoridation study, Hill et al (1959) it has been reported that over the period of fluoridation there has been a decrease in rates of all types of malocclusion in the 6 - 8 year and 12 - 14 year age groups. However, we shall have to await the results of the comprehensive study in Oslo, Norway, being conducted by Engh and his colleagues before any firm conclusions can be made relative to the importance of premature loss of teeth as a cause of malocclusion.

CHAPTER 5. Conclusions

159. One of the objects of the Committee's investigation was to determine, on the basis of evidence, the safety or otherwise of adding fluoride in a concentration of approximately 1 p.p.m. to municipal water supplies. Our conclusions in this connection are as follows:

i Although the main medical complication associated with prolonged, massive exposure to fluoride is that of skeletal fibrosis, and with the possibility of renal damage there is no evidence even to suggest that the prolonged consumption of water containing fluoride, many times in excess of optimal concentrations, has any deleterious effects upon the skeletal system of the body or upon renal function.

ii We are convinced that the long-term ingestion of fluoride at approximately 1 p.p.m. is in no way related to heart disease, cancer, intracranial vascular lesions, nephritis, gastric conditions, arthritis, liver disorders, diseases of the respiratory system, diseases of the nervous system, diseases of the cardio-vascular system, disorders or diseases of the blood cells, disorders of the eye, or ear, diabetes, disorders of the thyroid gland, the parathyroid gland, the adrenals or sex glands.

iii We are equally convinced that there is no deleterious or harmful effects of water-borne fluoride, at the concentrations under study, upon the height, weight or fracture experience of the individual, nor is there any adverse influence on pregnancy, the urinary system or on the skin.

iv There is no evidence to associate the intake of fluoride with any congenital abnormalities.

v There is no evidence to show that fluoride ions in the concentration of approximately 1 p.p.m. adversely affect the enzymatic system of the body.

vi We believe that it is physiologically impossible for any person to consume such quantities of water, containing approximately 1 p.p.m. fluoride, as would produce any harmful effects attributable to the fluoride content of the water.

vii We are convinced that a concentration of 1 p.p.m. of fluoride in drinking water is eminently safe over a very wide range of water intake.

PART VII

EVIDENCE IN ONTARIO

CHAPTER 1. Brantford-Sarnia-Stratford Study

160. Throughout this report reference has been made to the many studies carried out in various parts of the United States. The results of those studies have provided much of the evidence upon which the "fluoridation story" is based. That comparable findings have been reported in the United Kingdom, and various other countries, has been indicated. Mention has been made as well to the so-called Brantford study, but only briefly. The comprehensiveness, actually, of evidence available from studies and other relevant data in Ontario is such that specific conclusions are both warranted and justified.

161. Prior to the commencement of the fluoridation of the water supply in Brantford, it has been firmly established that:

i The presence of natural fluoride in a community water supply in concentrations of from 0.7 to 8 p.p.m. lowered the incidence of dental caries and had no deleterious effects on the human body, save the development of dental fluorosis when the concentration was in excess of about 2 p.p.m.

ii An optimal concentration of approximately 1.0 p.p.m. fluoride not only reduced the incidence of dental caries to a maximum degree but did so without producing dental fluorosis.

162. On these established premises, and in view of the magnitude of the dental caries problem in Ontario, the late Dr. W. L. Hutton, the then Director of the Brant County Health Unit, initiated the mechanical fluoridation of the water supply of the City of Brantford. The addition of fluoride to the Brantford water was controlled so as to obtain a concentration of approximately

1 p.p.m. of fluoride and thus Brantford became one of the first cities in the world to adjust the fluoride level of its water in order to evaluate the caries-reducing effect of added fluoride.

163. The study was commenced in 1945. Data are therefore available over a 15-year period. Brantford continues to fluoridate its water supply. In 1946 the Department of National Health and Welfare, on invitation, agreed to undertake a comparative study of the incidence of dental caries in Brantford, where the fluoride content of the water prior to fluoridation in 1945 had been less than 0.05 p.p.m.; in Sarnia (less than 0.05 p.p.m.); and in Stratford (1.3 to 1.6 p.p.m. fluoride). These three cities are in South Western Ontario and are similar in economic and ethnic background. Complete cooperation obviously existed between the Dental Health Division of the Federal Department of National Health and Welfare, the Research and Statistical Division of the same Department, the Ontario Department of Health and the local departments of health of Brant County (Brantford), of Stratford, and of Lambton County (Sarnia).

164. This study, and the results of the study, are of vital significance and deserve special, detailed attention at this time. Later in the report results from other areas in Ontario will be mentioned.

165. The selection of the study samples in each of the three cities (Brantford, Sarnia, Stratford) was done in keeping with accepted, standard epidemiological practices. Within the age groups 6 - 8, 9 - 11, and 12 - 14 the total number of children in each of the cities who were eligible for inclusion in the groups was based upon continuous residence in that city. Continuous residence was defined as continuous since birth with absences of six weeks or less being included. The study therefore compares groups of children who have consumed water containing approximately 1.6 p.p.m. fluoride since birth (Stratford), groups of children who have consumed virtually fluoride-free water (Sarnia) since birth, and groups of children who have used mechanically fluoridated water since 1945 (Brantford) but who before that date consumed fluoride-free water (less than 0.05 p.p.m.).

166. All primary and secondary schools in each of the three cities were canvassed for eligible children. And although the 6 - 8 year-old children were examined up to 1957, children of this age group were not examined in subsequent years because, as the Department of National Health and Welfare's Report (1959) states:

> "Since 1954 no significant differences were found to exist in the caries experience between the children of Brantford and the children of Stratford in this age group. It was therefore decided that no useful purpose would be served by continuing to examine children of this age and only the 9 - 11 and 12 - 14 age groups were included in the study after 1957".

This decision was certainly reasonable in the light of the data which have been presented in the various reports on the study produced by the Department of National Health and Welfare, in 1953, 1954, 1955, 1957, and 1959.

167. The methods of selection, of examining and recording were those outlined in, "A Suggested Methodology for Fluoridation Surveys in Canada" (1952). The method of sampling used was that known as a systematic sample with a random start. By 1953, 8 years after fluoridation was commenced in Brantford, the influence of fluoride in reducing the rate of dental caries in the children of that city was already evident.

> "Some idea of the extent of benefit can be obtained by comparison with the data for Sarnia ... By 1948 the Brantford data were not greatly different from those for Sarnia. By 1953 the proportion of Brantford children age 6 - 8 with caries-free permanent teeth was over twice as great as for Sarnia, and the mean D.M.F. tooth rate per child age 6 - 8 was 64% lower for Brantford than for Sarnia".

The Brantford children born in 1945 would have a full set of permanent teeth in 1957. The data therefore of 1959 are most pertinent since a significant comparison between the children of

the three cities relative to the mean D.M.F. rate and the caries-free teeth can be made.

168. It is important to emphasize the fact that all examinations throughout the study were done by the same examiner in an attempt to maintain as uniform observations as it was possible to do. The 1959 Report of the Department of Health and Welfare explains:

> "All examinations have been done by the same examiner, using a portable examining light of specific intensity kept at a constant distance, plane mouth mirrors and No. 5 Clev-dent explorers. The lowest limit in size for a caries lesion was defined as one in which the point of the explorer would stick and resist direct withdrawal, or in which softness could be felt. Hard, discoloured enamel surfaces and enamel imperfections were not recorded as caries. Any observable mottling was recorded. Oral hygiene was also recorded and classified as 'good', 'fair', or 'poor'. A chart depicting all the coronal surfaces of both permanent and primary teeth was used for recording. Although this report [1959] presents data only for D.M.F. permanent teeth and df (decayed and filled) primary teeth, tooth decay was recorded in the detail necessary for analysis by the number of surfaces affected. In addition every tooth space was accounted for in order that later analysis might be made in terms of a D.M.F. tooth record of all erupted teeth per child".

169. It must be emphasized here that there is a difference between examinations designed to obtain data for an epidemiological study and a clinical examination. The epidemiological study must rigidly define the phenomena for which one is examining. For example, a "carious lesion" must be defined and this may not mean the same thing to different individual dentists. The examiner will, however, be as consistent as is humanly possible, within the particular study.

170. In 1948 a total of 1,598 children in the 9 - 11 year age group and 1,450 in the 12 - 14 age group were examined; in 1959 a total of 1,550 in the 9 - 11 year age group and 1,468 in the 12 - 14 age group were examined in this Brantford, Sarnia, Stratford study.

171. Considering first the percentage of children having caries-free permanent teeth - actually having no cavities at all - in the three cities, the data show that some 50 per cent of the 9 - 11 year olds and about 28 per cent of the 12 - 14 year olds in Stratford, both in 1948 and in 1959, had caries-free permanent teeth. In Sarnia the corresponding percentages were, on the average, about 7 and 1.5. In Brantford, on the other hand, the 1948 figure for 9 - 11 year olds was about the same as for Sarnia, but by 1959 the 9 - 11 year-old group showed that 43 - 44 percent had caries-free permanent teeth. The picture for the 12 - 14 year-old group is equally striking in Brantford. In 1948 about 1 per cent of them had caries-free permanent teeth; in 1959 the percentage had increased to about 18 - approaching the corresponding Stratford figure of 28 per cent. The standard error, levels of statistical significance etc. are to be found in the original report of 1959, (Figure 2).

172. Tooth mortality, or tooth loss, is usually, except in the case of accidents or extraction for orthodontal reasons, the end-result of dental caries. We have been shown that a direct correlation exists between tooth mortality rates and dental caries rates. This is on the basis of the numbers of teeth extracted and/or indicated for extraction per 100 children relative to the numbers of teeth showing caries per 100 children. A reduction in dental caries by any means should therefore produce a reduction in tooth mortality. The records show that in 1948 the tooth mortality rate in the 9 - 11 and in the 12 - 14 year-old groups in Brantford was significantly higher than in the same age group children in Stratford. By 1959 the rate in Brantford had significantly decreased. The report (1959) states:

> "Inter-city differences indicate that a highly significant decrease in tooth mortality has occurred in Brantford children in the age groups examined

since 1948, the results for 1959 showing no significant differences in this characteristic between Brantford and Stratford children".

173. In an earlier section of the Committee's report the D.M.F. rate was explained. It is the accepted method of reporting the number of decayed, missing, and filled teeth as an index of dental caries. A significant decrease in the mean D.M.F. rate is of vital importance to the people of this Province. As we have mentioned, a striking reduction in the D.M.F. rate among Brantford children has taken place since 1945. Actually, in 1948 the incidence of dental caries was just about the same in Sarnia and in Brantford in the 9 - 11 and 12 - 14 year-old groups. The incidence in the Stratford children of the same ages was markedly lower, about one-quarter of the Brantford and Sarnia levels.

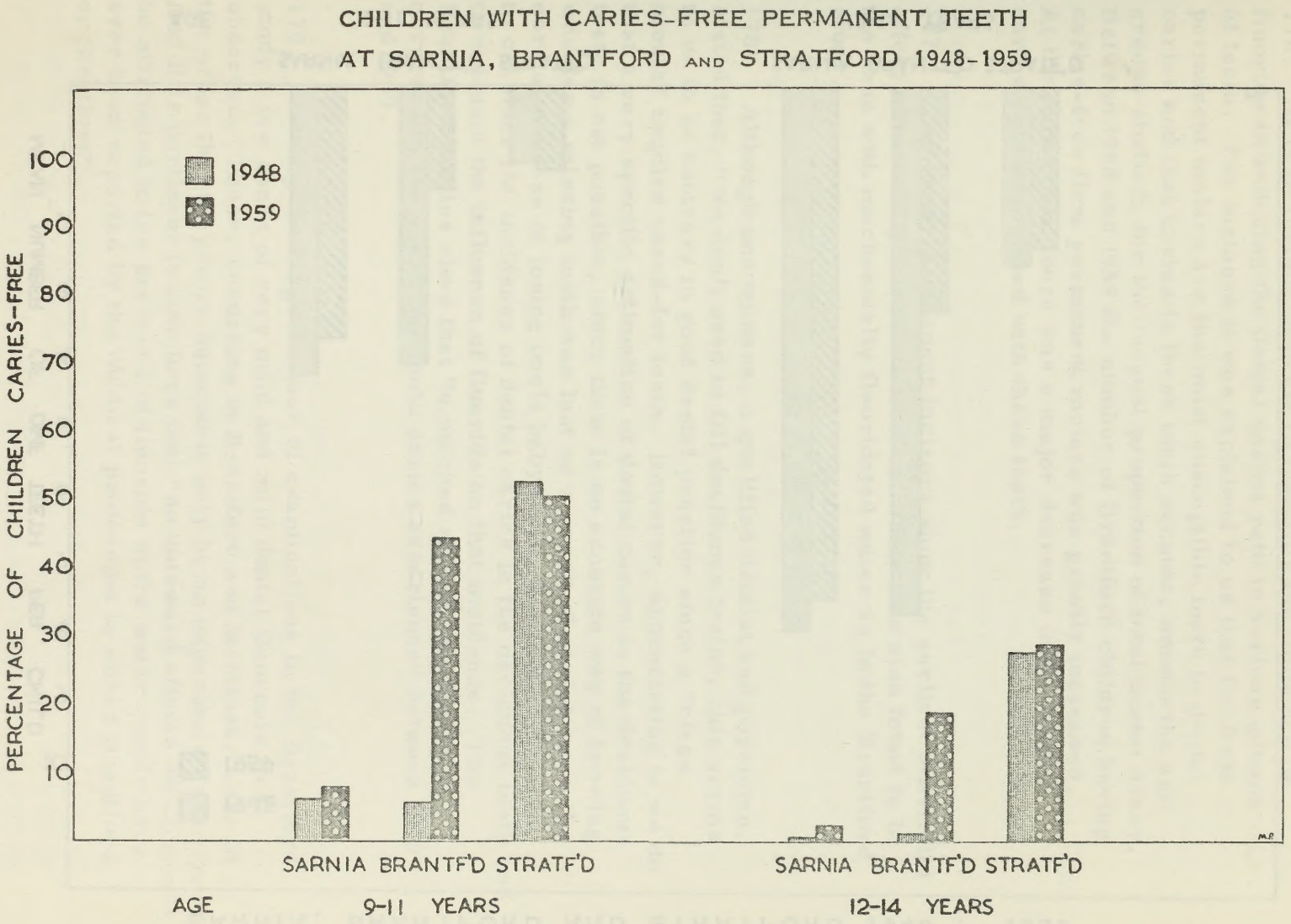
174. Expressing this statistically in terms of mean D.M.F. permanent teeth per child, the figures for the years 1948 and 1959 were:

Age Group	Year	Sarnia	Brantford	Stratford
9-11	1948	4.21±0.114	4.09±0.093	1.13±0.072
	1959	3.68±0.103	1.52±0.075	1.22±0.066
12-14	1948	7.94±0.200	7.68±0.164	2.55±0.130
	1959	7.46±0.197	3.23±0.127	2.33±0.103

The significance of these data may be more readily expressed by means of a block diagram (Figure 3).

175. These very significant data of the Department of National Health and Welfare have been substantiated independently by Dr. Hutton and his colleagues (1956) on the basis of twelve annual surveys involving 56,347 dental examinations of Brantford school children.

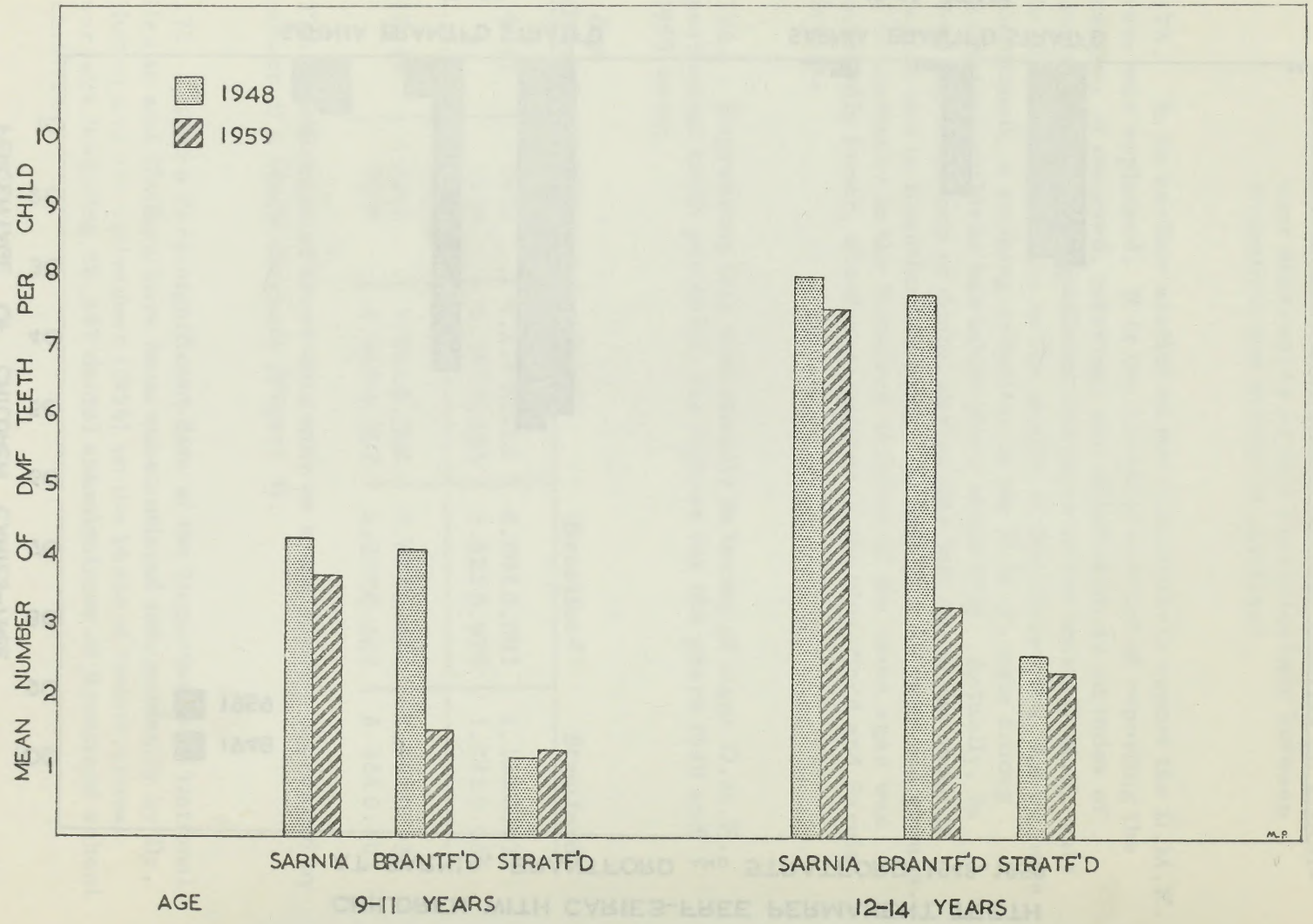
Figure 2



Department of National Health and Welfare, Ottawa, Canada. Dental Effects of Water Fluoridation, Seventh Report, September 1959.

Figure 3

DMF PERMANENT TEETH PER CHILD
SARNIA, BRANTFORD AND STRATFORD 1948 .– 1959



Department of National Health and Welfare, Ottawa, Canada. Dental Effects of Water Fluoridation, Seventh Report. September 1959.

176. It is of further interest to consider the influence of fluoride in reducing the dental caries rate in various groups of teeth. For instance it was explained to us that the first permanent molars are the most susceptible teeth to dental caries and that caries in these teeth account, among the age groups studied, for the largest proportion of total dental decay. Between 1948 and 1959 the number of Brantford children having caries-free first permanent molars was greatly increased. At the same time there was a major decrease in the dental caries rate associated with these teeth.

177. The upper permanent incisors show the earliest beneficial effect of naturally fluoridated water. This was also found to be the case with mechanically fluoridated water as in the Brantford study.

178. Although one witness, a qualified dentist and physician, stated that, "We don't need to fill deciduous teeth", this seems to us to be contrary to good dental practice since a "clean mouth" implies cared-for teeth. However, appreciating as we do that a very specific estimation of dental caries in the deciduous teeth is not possible, since there is no accurate way of knowing whether a missing tooth was lost as a result of caries or in the normal process of losing one's baby teeth, it is still important to consider the incidence of dental caries in the deciduous teeth and to evaluate the influence of fluoride on that incidence. The Brantford studies show that "a marked significant reduction occurred in the deciduous tooth caries experience" between 1948 and 1959.

179. During the large number of examinations in the Brantford study a few cases of very mild and mild dental fluorosis were observed. These, occurring in Brantford and Stratford, were of the order that they were detectable only by an experienced examiner. And it is pertinent to note here that "no untoward effects which might be attributed to the presence of fluoride in the water supply have ever been reported by the medical profession in either Brantford or Stratford".

180. As a result of an intensive investigation of all of the reports relevant to the Brantford-Sarnia-Stratford study we are convinced that:

i The mechanical fluoridation of a municipal water supply to the level of approximately 1 p.p.m. fluoride produces a marked reduction in the incidence of dental caries in children born subsequent to fluoridation.

ii The caries-reducing effect of naturally fluoridated water is basically the same as that of mechanically fluoridated water at the same fluoride concentrations.

iii The tooth mortality is markedly reduced in children who have consumed fluoridated water from birth.

iv Not only is a mechanically fluoridated water supply effective in reducing the incidence of dental caries in permanent teeth, it is also highly effective in reducing the incidence of deciduous tooth caries.

v The incidence of mild dental fluorosis resulting from mechanically fluoridated water is the same as that resulting from naturally fluoridated water and both are of about the same order of frequency and degree as found in persons in a non-fluoride area.

vi There are no ill-effects associated with the consumption of mechanically fluoridated water in concentrations of approximately 1 p.p.m.

CHAPTER 2. Other Ontario Data

181. As mentioned earlier there are many areas in Ontario where the natural water supply contains fluoride at a level of 1 p.p.m. or more. To ascertain any possible deleterious effects of such fluoride the Committee consulted the Medical Officers of Health of various relevant counties. And it should be emphasized that these men are highly qualified, efficient, and respected medical people. In this connection the following is taken from the official transcript of the Committee's hearings, Vol. 8, page 1753:

Mr. Cooper (Counsel for the Committee): Would you not agree that perhaps the best way to assess the extent of mottling in the various areas in Ontario, and we are [now] with Ontario, would be to speak to the people and Medical Officers of Health in those areas to --

Dr. Exner: I would say that was the worst possible way.

Mr. Cooper: And your reason for that?

Dr. Exner: Because I wouldn't believe what they told me.

Mr. Cooper: You are not willing to believe them, regardless of who they may be?

Dr. Exner: I don't want to get personal, but I wouldn't believe any Medical Officer of Health on the matter of fluorosis.

A Commissioner: How then do you expect us to believe what you say?

A Commissioner: Are not Medical Officers of Health honest men trained in medicine and/or dentistry?

Dr. Exner: I have no way of proving whether they are honest or not.

182. The Committee was quite prepared to acknowledge the integrity of the Medical Officers of Health in the Province of Ontario and to take cognizance of any comments which they wished to make. We appreciated the fact that most of their comments would be based upon opinions rather than on specific epidemiological data. The following are comments of Medical Officers of Health from fluoridated areas:

i "One dentist reports a high grade of dental status.

"The condition of children's teeth indicates where the child lives.

"We have no complaints of discolouration or mottling".

ii "For three years we have known that the village of --- has naturally occurring fluoride in excess of the amount recommended by the Department of Health. Our dentist feels that we have no less dental caries in this area than any other area where fluorides do not occur naturally".

iii "There is no record of any ill effects from ingestion of water containing fluorides in this area - naturally occurring fluorides are 4 p.p.m. here.

"Unanimous opinion [of the] medical and dental [profession] in this municipality is that fluorides are effective in preventing tooth decay. Possibility of harmful effects of added fluorides ... in these conditions is nil!

"Public water supply - deep wells - contains about 4 p.p.m. of fluoride. This has been in use since 1913".

iv "[no deleterious effects], agree on efficacy of fluoridation - presence of fluoride known in 1948. Public use since 1914. [Another area] public use since about 1910 or earlier".

v "I very definitely feel that no harmful effects can accrue if fluorides are used in recommended concentrations".

vi "There are four communities in the northern part of our county which have been using naturally fluoridated water supplies for 10 to 30 years ... I have never heard of any harmful effects on any individuals in this county from the areas that have naturally fluoridated water supplies".

vii "There is no evidence of any deleterious effects from the ingestion of water containing fluorides, either naturally or added, in the area under my jurisdiction. This answer is based on a continuing perusal of death certificates and also from morbidity reports received from

hospitals or practicing medical profession.

"Based on the reports mentioned above, I am quite convinced there are no possible harmful effects fluorides on individuals suffering from diseases of the kidney, diabetes, heart conditions or any other disease. It has been adequately proven to my satisfaction by others that human physiology and biochemistry is so ordered as to prevent any harmful effects in any of these diseases.

"The best opinion is that contained in a letter, which is attached, signed by all of the practicing physicians and dentists in the Thorold area when a Plebescite was held on whether or not fluoridation of the communal water supplies would be continued at the end of a five-year experience. It is inconceivable that 100 per cent of the physicians and dentists would sign such a communication if they had any fears or in their experience there had been any evidence that fluorides did anything but improve the overall health of the public by a decrease in the amount of dental caries by approximately 66 per cent in school-age groups.

"The presence of fluorides occurring naturally has been known since shortly after the institution of a dental Public Health Programme in this Health Unit area commencing in 1946, when it was found by the examining dentist that certain children in schools presented themselves with teeth showing little or no caries - the waters consumed were analyzed and found to contain fluoride.

"Specifically, some of these wells in the townships of Thorold, Crowland and Stamford, had been drilled and used by many generations of the same family for up to eighty years. In the Town of Thorold fluoride had been added on the recommendation of the Town Council and Public Utilities Commission since February, 1955. Where private supplies contain fluorides, we have carefully investigated the health of the persons consuming this water over a period of years. There is absolutely no evidence that the health of any of these persons was affected in any way except that many of

the elder citizens boasted of having perfect teeth; in one instance, at the age of 80 years.

"Further, it might be of interest to your Committee that one of the doctors whose name appears on the letter has been in charge of the Niagara Peninsula Sanatorium for approximately thirty years, during which period he has read thousands of x-rays, predominantly of the chest but often including some of the long bones of the body. He has assured me that even in older age groups, he has never found any evidence of fluoride deposition.

"Our dentist also has stated that the only example of fluorosis he has discovered after examining approximately 16,000 children annually, was in an immigrant child whose place of birth was Naples, Italy!".

viii "I have lived in Stratford all my life and have practised here for 39 years and have not known any deleterious effects. The public water system started about 1917".

ix "As you know, Brockville water supply has been artificially fluoridated for a period of time [since 1956]. It appears to be the concensus, among medical and dental practitioners with whom this office has been in contact on this matter, that the fluoridation of water supplies is a very useful adjunct in the prevention of dental caries".

x "Our municipal water has been fluoridated for many years, and I have not heard of any harmful effects on individuals with kidney disease, diabetes, heart conditions or any other diseases. Our medical and dental people are firmly convinced that fluoridation of the water supply has had good effects in preventing dental caries in children. The School Dentist in particular has often commented on the reduction of dental caries, and he should know as he examines all of our 1,000-odd Public School children twice yearly".

xi "The prevailing opinions of the dental profession in this city are that there has been marked improvement in the dental health of our children since the introduction of fluoride, and that the prevailing opinions of both medical and dental people are that no harmful effects have been noted ... No teeth mottling in this city".

xii "One of 17 municipalities comprising this Health Unit is using fluoridated water [for five years]. We have absolutely no knowledge of any harm being done to residents in this area".

xiii "There is no record of any deleterious effect of the ingestion of water containing fluorides ... in the area under my jurisdiction".

xiv "It is the opinion of the medical and dental professions in this area that fluoride has been quite helpful in the control of dental caries in the school children".

xv "I wish to say that as Assistant Medical Officer of Health from January 1st, 1946, to December 1st, 1958, I was in charge of the school health service of the Brant County Heal th Unit. During that time I personally examined thousands of school children in both urban and rural schools. As time passed I became increasingly aware of the number of children in Brantford who had caries-free teeth, as compared with rural school children who had had no fluoridated water. Such an impression, reinforced as it has been by carefully and independently prepared statistics, has remained unchanged. I am convinced that water to which has been added fluorine in 1 part per million helps to prevent dental caries in children".

183. The opinions of many of the Medical Officers of Health that there is no readily detectable mottling of the teeth resulting from the ingestion of fluorides over long periods of time was substantiated by Dr. Sutherland at the public hearing of the Committee. Dr. Sutherland is in charge of the Dental Health programme within the Sudbury District Health Unit. The City of

Sudbury adjusted the fluoride content of its water to 1 p.p.m. in August, 1952. The surrounding township area within the Health Unit does not have fluoridated water supplies. He stated:

> "I was struck yesterday by the amount of attention which was given to the matter of the mottling of teeth. I should tell you that my work has included not only examination of all of the children, but the meticulous examination of samples of children in order to establish any differences in the dental conditions which might be attributed to fluoridation. And in that connection we established the residency of the primary school children as to whether they are continuously residents in the non-fluoride area of the Township surrounding or continuously resident since birth in Sudbury. On that basis, I should tell you that we recognize a mottling of a nature which was described here, but I think more pronounced as was indicated in the slide, white speckling of the teeth. But in my experience, and on the basis of whether they are resident of the fluoride or non-fluoride area, it occurs with equal frequency in one place as in the other. I therefore cannot attribute what I observed as mottling due to fluoridation. In addition ... in my experience I have never seen what is described in the textbooks ... or in the literature, as brown stain mottling. This I have never seen. What I have noted I would describe as moderate and occurring with equal frequency in the two populations which I have described".

Under questioning it was revealed that 16,000 children had had dental examinations during the previous year and that not more than one in one hundred had shown evidence of mottling, and even in these cases, from both fluoridated and non-fluoridated areas, the mottling was such that a lay person would not detect it.

184. Dr. Jarrett, the Dental Health Officer for Wellington, Halton and Wentworth Counties, likewise volunteered evidence

at our public hearings. In general the municipal water supplies in the northern part of Wellington County contain from 0.7 to 1.4 p.p.m. of fluoride. The water supplies in the southern portion of the County contain, in general, minimal amounts of fluoride. Mount Forest has been using the same source of water for about 18 years (1.0 p.p.m.), Fergus (about 0.7 p.p.m.) for about 60 years and Arthur (about 1.4 p.p.m.) for more than 10 years. That the mottling which was noticed, examined by special light, was slight was indicated by Dr. Jarrett when he said:

> "From our examinations, it is only between one and two in one hundred children in the junior age group that have it. Quite possibly half as many again ... possibly three per cent ... in the permanent teeth. It is not common at all".

These observations were based upon the annual examination of about 12,000 children.

185. The D.M.F. rates in the children of various municipalities of Wellington County were also examined at the hearings. Harriston (0.8 p.p.m. at the time) children had a 3.4 D.M.F. rate, Palmerston (0.0 p.p.m.) had a 5.3 D.M.F. tooth count, Mount Forest (1.2 p.p.m.) children had a 3.6 D.M.F. tooth count, and Arthur (1.4 p.p.m.) had a 2.3 D.M.F. tooth count. All of the examinations were done by Dr. Jarrett. The lower D.M.F. rate in the fluoride municipalities was of the same order as that found in Brantford where the 1944 D.M.F. rate was 6.2 and after 10 years of fluoridation the average D.M.F. rate was 3.6

186. In order to compare mortality rates in fluoride and non-fluoride areas within the Province of Ontario, the Committee requested that such a study be made. Drs. Buck and A. H. Sellers, the Director, Division of Medical Statistics, Ontario Department of Health, conducted the study using the data from 18 selected municipalities which had a water fluoride concentration of 1.0 p.p.m. or greater and which could be paired with a nearby municipality of reasonably comparable size, having a water fluoride concentration of 0.0 to 0.4 p.p.m.

Age-adjusted rates of mortality from all causes, stillbirth rates and infant mortality rates were computed for each of the 36 municipalities. The summary and conclusions of this study are:

> "Recent mortality data have been examined for 18 pairs of 'fluoride' and 'non-fluoride' municipalities in Ontario and for the three cities,, Stratford, Brantford, and Sarnia. Comparisons of mortality from all causes, of stillbirth rates and of infant mortality rates have been made. Mortality from cardiovascular diseases and cancer has been compared for those municipalities for which vital statistical tabulations are available in sufficient detail to permit the computation of age-adjusted, cause-specific rates. A consistent pattern emerges from these analyses. The variation in mortality is greater within the fluoride and non-fluoride groups of municipalities than between them. In some instances the fluoride minicipality has the higher rate of mortality while in an almost equal number of instances the non-fluoride municipality has the higher rate. Furthermore, differences, between pairs of municipalities bear no relation to the concentration of water-fluoride in the 'fluoride' member of the pair.
>
> "This pattern indicates that the mortality rates under consideration are not influenced by the fluoride concentration of the water supply".

187. The Committee is satisfied that the evidence from Ontario areas other than Brantford, Sarnia and Stratford, confirms our findings respecting those cities set out in paragraph 180. The Committee is convinced that the mortality rates in the Province of Ontario are not influenced by the presence or the concentration of fluoride in the water supply.

PART VIII

MECHANICAL AND ECONOMIC ASPECTS OF FLUORIDATION

188. All the information obtained by the Committee substantiates the view that there are no significant mechanical or engineering problems associated with the addition of fluoride ion to the water of a municipal system. The equipment needed for this purpose and the techniques employed are quite similar to those already used in the treatment of communal water supplies throughout Ontario. There has been a considerable amount of information and experience gained in the eight municipalities in Ontario that have implemented a water fluoridation programme, and there have not been any reports of serious complications in the procedures adopted in communities ranging in size from the City of Sudbury to the Town of Deep River.

189. The machines used for the addition of fluoride to the water supply may employ a variety of techniques. The most common method used in Ontario is the dry type feeder in which the fluoride compound in powder form is placed in a hopper and fed at a controlled rate into a solution chamber. At this point water is added to the powder and the fluoride compound goes into solution. This highly concentrated fluoride solution is then fed into the water system at any designated point in that system. Apart from the possibility of mechanical difficulties inherent in any water works operation, the essential principle is quite simple. The addition of fluoride compound is coordinated with the rate of flow of the water so that a relationship is maintained which will result in a solution of approximately 1 p.p.m. of fluoride ion. The coordination of rate of flow through the water plant and the addition of fluoride can be achieved through the use of automatic controls or through manual changes in the feeding speed of the fluoridation machine to compensate for increased or decreased rates of water flow.

190. While fluoridation methods are both reliable and accurate, it is impossible to maintain a constant solution of fluoride ion at 1 p.p.m. The margin of error involved, however, is extremely small and water works engineers are able to keep the fluoride

solution within a given range and average the desired concentration of 1 p.p.m. The experience of Brantford water works operators over the past fifteen years illustrates this fact. When trying to achieve a constant solution of 1 p.p.m. fluoride ion it was found that, while they were able to average 1 p.p.m. in time, they were, on numerous occasions, fluoridating at a level of less than 1 p.p.m. Thus, in 1949, a new standard of 1.2 p.p.m. was set and, in this way, they were able to assure that the fluoride ion in the water system did not fall below 1 p.p.m. nor over the maximum permissible level of 1.5 p.p.m.

191. The fact that fluoridation of a water supply can be controlled within a given range but not at any precise level is not unreasonable when the amount of fluoride ion in relation to the amount of water is considered. A 20 or 30 per cent variation from the optimal concentration of fluoride ion in water is not too important since it represents only a range of 0.7 to 1.3 parts of fluoride ion to 1,000,000 parts of water. Furthermore, the experience of communities fluoridating their water supplies in Canada and the United States has amply demonstrated that the fluoride levels can be maintained within fairly precise limits, well under those which are considered toxic through continued ingestion.

192. The technique of water fluoridation is comparable to the chlorination of water or the use of any other chemical substance in the treatment and purification of water. There is no reason to expect that an excessively large quantity of fluoride could be accidentally added to the water supply. The safety factor in fluoridation is enhanced by the fact that mechanical failure of the equipment will result in cessation of the operation, cutting off the supply of the fluoride compound. Secondly, the amount of fluoride compound contained in the hopper of the machine is not sufficient to produce a toxic dosage even if all of the contents of the hopper went into solution in the water supply at the same time. The possibility of human or mechanical failure cannot altogether be discounted, but as is the case with the addition of chlorine and other chemicals to the water supply, proper safety measures can be taken to reduce such a possibility to a minimum and to insure that even if an accident occurred, the water would not contain enought fluoride ion to reach a toxic level.

193. To ensure that fluoridation of public water supplies is maintained within the prescribed limits, periodic checks of fluoride ion concentrations are made by the water works chemist at the plant and by the Ontario Water Resources Commission. In Brantford, a test of the finished water in the plant is made every day to determine fluoride content. In other areas, samples taken by the water works employees are forwarded to the Ontario Water Resources Commission for chemical analysis. In addition to these practices inspectors from the Commission are continually examining water works operations, including fluoridation systems, throughout the Province.

194. In attempting to maintain a constant fluoride level of 1.0 p.p.m. or 1.2 p.p.m. in a water supply, one must recognize the variations that occur in the fluoride levels throughout the distribution network. A check of fluoride concentration at the plant and at some other point in the system will often reveal differences in the fluoride concentration. This is a result of a time lag in the flow of water between the plant and the consumers in the community. Therefore, a fluoride concentration of 1.2 p.p.m. may be ascertained at a plant outlet, while at the same time a slightly different level may be obtained at an outlet located several miles from the plant. However, if the 1.2 p.p.m. concentration could be maintained over a period of time, all outlets in the distribution system would give the same concentration. There is no evidence available to substantiate the view that there is any loss or build-up of fluoride ion in a distribution system. The variations that do occur are the result of time differences between the addition of fluorides at a water treatment plant and the circulation of that water through the water mains in a municipality.

195. Evidence was submitted at the public hearings relative to the relationship existing between fluoridation and the possibility of increased corrosion in pipes and water mains. The documentation supporting this contention was questionable because it was incomplete as to the chemical components making up the rust samples taken from the affected pipes. A comprehensive survey of the water engineering problems associated with fluoridation, Ingram and Moore (1959), showed that in no instance was any pipeline corrosion traceable to the fluoride content of the water in the twenty cities included in the study. Another study by McCarthy (1959) reported that the absence or presence of fluoride at a concentration of 1 p.p.m. in water with a pH of 6.7 has no effect in the corrosion of iron, copper, or lead. Further, the Committee

could find no evidence relative to corrosion and fluoride concentrations in those areas of Ontario now fluoridating water supplies. From the evidence available, the Committee is convinced that fluoride is not a factor in the corrosion of water mains, pipes and fittings in a community whose municipal water supply contains fluoride. Furthermore, we have found no evidence that fluoridated water interferes in any way with the mechanical equipment or industrial processes including the preparation of food products. Neither has there been any evidence that fluoridated water adversely affects any enzyme used in fermentation.

196. One of the chief complaints regarding the fluoridation of public water supplies advanced by many individuals both at the public hearings and in the briefs sent in to the Committee is that such a programme is both costly and wasteful. It has been pointed out that less than one per cent of the total water supply to which fluorides have been added will be consumed by those individuals who will receive benefits. More than 99 per cent of the expenditure on the purchase of fluoride compounds and equipment and maintenance and operating expenses will be wasted. It is argued, therfore, that it would be cheaper for a community to supply fluoride in other forms directly to children.

197. The above argument fails to take into account several factors. Without considering the problems associated with the safety or efficacy of fluorides in any other vehicle than water, the individuals advocating this point have not considered the total cost involved in the administration of such programmes. The purification of a communal water supply may also be considered costly and wasteful since the bulk of the water is not used for human consumption. The annual cost per capita of fluoridation has been variously estimated, but a 10 cents per capita per annum figure is a reasonable estimate based on the costs involved in fluoridation by communities throughout Canada and the United States. In terms of the individual citizen it has been pointed out that in the first five years the average child in Toronto will probably have 4 teeth affected by decay requiring about 8 dental restorations. A conservative estimate of the cost of these dental restorations would be $35.00. If the child had been raised in a community with fluoridated water, the saving of the average individual might be

50 per cent or about $17.50. Thus the cost of fluoridation must always be considered in the light of the expected economic savings due to the reduction in the restorative dental work required, the social desirability of improving the dental health of the population and the feasibility and economic cost of any alternative method of administering fluorides.

198. The Committee is satisfied that:

i The equipment in use in municipal water systems in Ontario for the addition of fluoride to the water is mechanically adequate for this purpose and the concentration of fluoride is and can be controlled within the limits of optimal effectiveness and safety;

ii There is no loss or build-up of fluoride ions within a municipal water system;

iii The presence of fluoride in the recommended concentration in water does not cause corrosion of water mains, pipes or fittings;

iv Fluoridated water does not adversely affect in any way industrial process;

v The cost of fluoridating a municipal water supply is very reasonable in relation to the health benefit to the community.

PART IX

OTHER FORMS IN WHICH FLUORIDE CAN BE ADMINISTERED

199. Most of the information available regarding the dental and medical aspects of fluoridation comes from studies in which fluoride was ingested in drinking water. Since approximately one-third of the children and adults in Ontario do not have access to public water supplies, information regarding fluoride administration in a vehicle other than municipal water supplies is important, from a dental health standpoint, to a large part of the population. However, under its terms of reference, the Committee has devoted its attention mainly to the problem of the fluoridation of public water supplies. Nevertheless we have, during the course of our investigations, gathered together a considerable amount of material related to the various other methods by which fluorides can be administered, and this is summarized in the following paragraphs.

200. Methods suggested for administration of fluoride other than through communal water supplies are the use of fluoride tablets (either sodium fluoride, calcium fluoride, or bone meal), fluoridated salt, fluoridated milk, topical application of fluorides, concentrated fluoride solutions, and home fluoridation equipment. While there have been a few scientific studies conducted relative to several of the above methods, the bulk of the scientific investigations studied were directly concerned with the medical and dental effects of controlled or naturally fluoridated communal water supplies. In this connection, it is important to emphasize that the information regarding the safety and effectiveness of the ingestion of communal water supplies fluoridated at approximately 1 p.p.m. cannot be used in assessing the probable metabolic activities of fluorides obtained from other vehicles due to the differences inherent in the method of administration.

201. One of the alternative methods which has been subject to extensive scientific enquiry has been the topical application of fluoride to tooth enamel. There is some evidence that water-borne fluorides may inhibit dental caries by exerting a topical

effect. However, studies on this question have generally been made on animals. No topical effects in animals have been found when the concentration of fluoride in water was as low as 1 p.p.m., Wynn and Haldi (1955), but if the concentration was 10 p.p.m. or more, results were readily observed, McClure (1941), Finn and Hodge (1941), Muhler et al (1953). While there is some indication that water-borne fluoride at relatively high concentrations (3 p.p.m. or more) may inhibit dental caries in humans by exerting a topical action, Klein (1945), Mavrogordato (1951), evidence for such an effect where the fluoride concentration is 1 p.p.m. is not satisfactory.

202. The information gained from studies of the topical effects of water-borne fluoride led to the development in techniques for the application of concentrated fluoride solutions to the teeth directly. Studies using a 2 per cent sodium fluoride solution (20,000 p.p.m.) were conducted on children, Knutson et al (1947), Galagan and Knutson (1947). Over a period of from one to three years, the results were relatively uniform, - indicating approximately a 20 to 40 per cent reduction in new caries developing in the teeth treated. There is evidence however that this effect becomes reduced in time after the applications cease, Syrrist and Karlsen (1954), Syrrist (1956). The results of applying sodium fluoride solutions to the teeth of adults have not been so clear-cut, although the two studies evaluating acidulated sodium fluoride solutions agree that it is ineffectual in reducing caries in adults, Arnold et al (1944), Rickles and Becks (1951). On the basis of the results there seems little reason to expect that applying topical sodium fluoride solutions to adult teeth will result in caries inhibition comparable to that observed in children.

203. More recently, extensive studies have been made on the efficacy of some of the other salts of fluorine, particularly stannous fluoride. In general solutions of the stannous salts of fluorine have been shown to be considerably more efficient in reducing caries than sodium fluoride solutions when applied topically. Reductions of from 35 to 60 per cent in new caries surfaces have been observed in school-age children following the use of stannous sluoride. Compton et al (1959) reported a caries reduction of 28 per cent in primary teeth of pre-school children in Toronto, and Muhler (1958) reported a caries reduction of 16 per cent in young adults. These data are contained in the reports of the first year of the studies which are continuing. Other similar

studies are in progress.

204. There seems to be no doubt that the topical application of sodium or stannous fluoride, even in the adult, materially reduces the incidence of dental caries. That this can be achieved with about four applications of 2 per cent sodium fluoride or with an annual application of 8 per cent stannous fluoride would seem, at first glance, to be contrary to the findings that to obtain a major reduction in the dental caries rate it is necessary to ingest fluoridated water of a concentration of approximately 1 p.p.m. from the time of tooth development. The explanation of this seemingly inconsistent fact lies in an appreciation of the chemical action of the topically-applied fluoride. When sodium fluoride in high concentration is applied to the developed tooth the fluoride is freed and chemically joins the enamel crystal surface, Hodge (1960). This in turn makes the enamel surface less soluble in the organic acids in the mouth formed as a result of the break-down of carbohydrates. The concentration of fluoride in the surface enamel of the tooth increases, by such applications of sodium fluoride, to approximately 1200 p.p.m., Brudevold et al (1956, 1957). With stannous fluoride the same general chemical reaction takes place as with the sodium salt but in addition there may be a further chemical compound formed which provides a coating over the enamel surface. This, too, resists for a time the action of the organic acids formed in the mouth. In both of these cases, stannous fluoride or sodium fluoride, the concentration in the tooth enamel decreases with time and for continued effectiveness must be renewed through further topical applications. In effect the topical application of concentrated fluoride solutions in building up an enamel surface fluoride concentration to about 1200 p.p.m. is duplicating the 1500 p.p.m. concentration of fluoride derived from ingested fluoride. However, the ingested fluoride, from communal water supplies containing trace amounts of fluoride, 1 p.p.m., not only produces a surface concentration of fluoride but as well a concentration in the deeper layers of the enamel. Thus ingested fluoride not only decreases the incidence of dental caries but, as well, retards in depth and spread - which topically applied fluoride does not - those few caries which may develop. The topical application is, in a sense, non-permanent and must be repeated at intervals. In general then, from a public health standpoint, topical application of fluoride cannot, for several reasons,

be considered directly comparable to water fluoridation as a means of reducing the incidence of dental caries. Firstly, the results are relatively limited when compared to those accomplished by water fluoridation. Secondly, the amount of time required by the dentists and hygienists to effect the topical applications for each person is considerable and expensive. Finally, the series of treatments must be repeated as new teeth erupt - hence the initial cost as well as the subsequent costs per person are great. It should be recalled, too, that the greatest effectiveness of fluoride is to be gained when the fluoride is ingested throughout the period when the teeth are developing - both deciduous and permanent - in the pre-eruptive stages.

205. Studies evaluating the use of dentifrices containing stannous fluoride as a means of preventing caries have also been carried out. The American Dental Association (1960) has evaluated the scientific evidence related to the use of a particular brand of dentifrice and has given its approval to the claims made for this product. The American Dental Association advised the Committee as follows:

> "I should emphasize the fact that the Council on Dental Therapeutics does not regard the use of Crest as being in any way a substitute for controlled fluoridation of community water supplies. The Council regards fluoridation as being the most effective and safest method of providing dietary fluoride to children for the purpose of developing decay-resistant teeth. The Council would regard Crest toothpaste as one method for the application of stannous fluoride to the surfaces of erupted teeth. It is presumed that the principal value of the topical application of fluoride solutions to the teeth of children by dentists, and of the use of Crest in a program of home oral hygiene will be obtained by those persons who do not have access to fluoridated water or did not have access during the period of the development of their teeth".

206. Heid and Piguet (1954, 1956) reported on the caries reducing effect of the ingestion of sodium fluoride tablets by children ranging in age from five to eight years over a subsequent period of three years. A caries reduction of 85 per cent was reported in the total number of new carious surfaces developed over the three years, but the experimental method used made it impossible to interpret this reduction as applicable to a complete population. In addition, these results were only partially verified by other studies, Schmid-Kunz (1956), Schar (1959). A considerable amount of scientific work is presently in progress to determine the effectiveness of providing fluoride in tablet form.

207. Several witnesses suggested that the use of fluoride pills would be more acceptable on several grounds, particularly moral and economic, for the ingestion of fluorides in the attempt to reduce the incidence of dental caries. They were unable to give any evidence to prove the efficacy of such fluoride pills. While one expert witness stated that the available evidence demonstrates that a supply of fluoride of about 0.5 - 1.0 mg. per day through the time of formation and maturation of teeth causes a significant reduction in dental caries, he went on to point out that the availability of tablets, even on a free basis, will not ensure that all children would receive them; the cooperation of parents would be essential and one has only to consider other aspects of the health of children to realize the difficulty of obtaining the full cooperation of all parents.

208. The main difficulty running throughout the discussions on the efficacy of fluoride pills revolves around a fundamental misunderstanding of the differences inherent in water fluoridated at a level of 1 p.p.m. and water with a solution of 1 mg. of fluoride ion. While epidemiological studies have demonstrated the efficacy and safety of water containing fluoride ions at the level of 1 p.p.m., these same studies do not necessarily verify the efficacy or safety of the ingestion of 1 mg. of fluoride ion in solution. However, many witnesses confused the optimal amount of fluoride at 1 p.p.m. as equivalent to 1 mg. of fluoride. This is, of course, not correct.

209. One witness submitted a brief and discussed at the public hearings the use of a home fluoridating unit. This unit is designed to supply fluoridated water at the optimal level of 1 p.p.m. at any selected tap in the home. The unit is considered by its manufacturers as a method by which a family, not supplied by a fluoridated communal water supply, may enjoy the benefits of fluoridated water.

210. Two witnesses argued that a fluoride solution may be obtained from a druggist so that a measured dose would be the equivalent of 1 mg. of fluoride. Here again, there was no evidence submitted with regard to the safety or efficacy of such a method. The present objections to the use of pills apply with equal force to this proposed method of fluoridation. It should be pointed out that the storage of pills or highly concentrated fluoride solutions may present a dangerous health hazard in the home, which condition is absent where the communal water supply contains fluoride in the proper concentrations.

211. There has also been a considerable amount of work done on the addition of fluorides to other liquids and foods in order to supplement the individual's fluoride intake. Kitchen salt containing 200 mgs. of sodium fluoride and 10 mgs. of potassium iodide per kilogram of salt is available to large sections of the population in Switzerland, Wespi (1956). The report by Schmid-Kunz (1956) comparing the caries increment of groups of children six to fourteen years, using fluoridated and non-fluoridated salt showed no significant difference between the groups. The age group of these children, and the length of the administration of the salt, precludes a satisfactory study. Light and his co-workers (1958) investigated the effect of fluoridated milk. Contrary to a study on fluoride utilization by rats, Muhler (1955), they found that the fluoride added to milk may be readily available to the human subject, and that adding fluoride to milk increases the quantity of fluoride in the teeth. More recently, a paper presented at the Fifth International Congress on Nutrition, Rusoff et al (1960), indicated that there was an 80 per cent reduction in dental caries in young school children drinking milk fluoridated with 1 mg. of sodium fluoride per half-pint container. The use of a vehicle, such as milk, etc., as an alternative to municipal water supplies for the purpose of providing fluoride is an attractive possibility. There are

such studies in progress at the present time and undoubtedly additional research is being contemplated. But, in view of the paucity of scientific evidence covering the many important facets of this problem and the necessary time lag before such evidence could be evaluated, the Committee cannot comment further on the matter.

212. The Committee believes that at the present time there is no practical alternative to the fluoridation of municipal water supplies in those areas where such water supplies do not contain approximately 1 p.p.m. of fluoride. It is possible, however, that the results of the studies presently in progress relative to the topical application of concentrated fluoride, the use of an alternative vehicle, such as milk, or the ingestion of fluoride in a satisfactory tablet form may provide an acceptable alternative which could be of particular value to those living in rural areas. The Committee is very conscious of the fact that the evaluation of such studies as are being conducted in this connection will require many years before results can be assessed. And in addition the Committee, while mentioning these pending developments, is concerned that since such methods of ingesting fluorides are of necessity a voluntary procedure sight may be lost of the great and proven public health benefits to be derived from the consumption of fluoride-containing municipal water.

PART X

CIVIL RIGHTS

213. The last topic upon which we heard submissions at the public hearings was civil rights or liberties and fluoridation. At that point in our inquiry, we had reached no conclusions upon any of the other issues. The arguments on this topic covered a wide and interesting field with frequent references back to the evidence heard on the other topics. The proponents of fluoridation did not admit that this issue presented any difficulty. They argued that as it has been demonstrated that fluoridation materially reduced dental caries, did not injure the body and was economically and practically feasible, it was the plain duty of this Committee to recommend that it should be authorized. In fact, the Health League of Canada demanded that we should recommend the enactment of legislation which would compel municipalities to fluoridate their water supplies. On the other hand, the opponents of fluoridation, who had submitted evidence on the other topics, contended, relying in the main upon their earlier submissions, that the introduction of fluorides into municipal water supplies would be a clear violation of the individual's civil rights.

214. Our findings and conclusions contained in the earlier parts of this Report do not, in our view, automatically provide the answer to the question of civil rights. If our findings upon the topics already considered had been adverse to fluoridation, we would, of course, have reported against it without expressing any opinion on civil rights; in such circumstances the answer would have been obvious. The reasoning upon which our opinion on this topic is based cannot be stated briefly. Before dealing directly with this important problem, we must take some time to discuss the context within which it falls and to state the real issue as we understand it.

215. We will briefly mention some of the principal submissions made by the opponents of fluoridation upon this topic. They were: the fluoridation hypothesis has not been proved; the possibility and probability of damage to bodily organs; children are the only persons who would receive the benefit, if any; the reduction, if

any, of dental caries, can be achieved by other methods which permit individual choice; and the expense of the process outweighs any possible benefit.

216. These contentions were fully considered in earlier parts of this Report and we have expressed our conclusions and made findings with respect to them which we summarize as follows:

i The incidence of dental caries in Ontario is of such magnitude that it must be regarded as both a serious and major public health problem and the reduction of dental caries is a problem of prevention and not one of treatment (paragraph 60).

ii The presence of fluoride in a municipal water supply in the recommended concentration of 1 p.p.m. strikingly reduces the incidence of dental caries when such water is consumed during the period of tooth development and the dental caries reducing effect of fluoride extends into adult life (paragraph 102).

iii The long-term consumption of water containing the recommended concentration of fluoride is not harmful to bodily health (paragraph 159).

iv The fluoridation of municipal water supplies is the most practical, feasible, safe and economical method of conferring this benefit upon the public (paragraph 198) and there is no practical substitute for it (paragraph 212).

We are convinced beyond any reasonable doubt of the truth of these findings. This conviction renders the contentions mentioned in paragraph 215 irrelevant to the issue of civil rights and fluoridation as we conceive it.

217. From representative briefs we extract the following statements which focus the civil rights issue within its proper limits.

i "The right to decide what shall be done to one's body is, perhaps, the most fundamental of the liberties which are cherished in your country and in mine. Without it all other liberty becomes meaningless. When public officials are granted the right to drug people without their consent and when public safety is not even involved, there is no limit to what they can do, or to whom. We dare not entrust such power to anyone. The purpose of government is to defend al rights both majority and minority. Of the two, the latter are the more important, since the majority doesn't do anything it doesn't want to do. No government has any right, with or without a vote of the people to decide what drugs any person must take or what foods he must eat. Fluoridation lies wholly beyond the powers of any decent government". (Dr. F. B. Exner)

ii "Even in the event of a majority vote in favour of fluoridation, the right of an individual would be abridged. Our regard for personal liberty forbids us to impose something upon another individual on the pretext that it is for his own good. The contemplation of fluoridation has no place in a democracy. It lies wholly outside the proper sphere of governmental action and should be handled in the same manner as any other medication - on a personal and individual basis only". (Pure Water Committee of Kingston)

iii "The ordinary and time-honoured relationship of physician and patient is that the physician advised but it remains optional with the patient to accept or reject the proferred advice. If a physician subscribes to this principle how then can he logically advocate compulsory mass medication or fluoridation? In prescribing mass fluoridation he is prescribing a treatment to a vast number of people whom he has never examined. He is prescribing it in such a way that they have no option but to take it. He is prescribing it regardless of need and regardless of consequences ... To advocate compulsory mass treatment, the physician must step completely out of character, unless of course we

are dealing with a virulent disease of epidemic proportions, which dental caries definitely are not". (G. G. Kew)

iv "The Christian Science Church, and Christian Scientists individually, protest the compulsory medication involved in the treatment of public water supply with fluorides as an unquestionable infringement of the rights of religious freedom ... Fluoridation of our water supply system constitutes compulsory mass medication, and, therefore, we are opposed to it and hold that arbitrarily to force it upon the public would be an invalid extension of the police power of the State ... Fluoridation also encroaches upon the right of freedom of religious worship for those who depend upon prayer rather than upon drugs to maintain health. Therefore to force this method of mass medication upon the citizens of the Province of Ontario constitutes a violation of their basic religious right ... Let me say in conclusion, that Christian Scientists are vitally concerned with health and all phases of public interest. It is our sole purpose to aid in maintaining the inherent rights of free men and at the same time avoid any precedent in this field, which, if once established, could lead to numerous encroachments through forced mass medication". (Christian Science Committee on Publication for Ontario)

v "In view of the effectiveness and safety of fluoridation and having regard for the vast array of professional and lay organizations which endorse fluoridation, the creation of legislation to permit Ontario communities to avail themselves of the public health benefits of fluoridation would constitute a reasonable and desirable function of responsible government". (Royal College of Dental Surgeons of Ontario and the Ontario Dental Association)

vi "Satisfactory precedent also has been established

whereby the State may impose restrictions or order specific programs because of their wide spread public benefit ... the failure to add fluoride is such a violation of civil liberties because the League believes that a moral responsibility rests upon the community to achieve the highest possible level of health consistent with scientific and economic ability for each member of the community". (Health League of Canada)

vii "There is no practical substitute for the fluoridation of municipal water supplies. This leaves a very simple choice - acceptance of a harmless increment in daily fluoride intake or total deprivation of all of a benefit that might otherwise be enjoyed. The simple question of whether there is a right to ask people to agree is thus transformed into the much more far-reaching issue of whether there exists any morally tenable grounds for withholding consent. If the price of social existence is measurable in terms of freedom, then the proposal to relinquish one freedom in order to gain a larger freedom - a freedom to enjoy better dental health - is, in the view of this Association, the over-riding consideration, and one which is held to be entirely compatible with those high ideals which Canadians rightly cherish". (Canadian Public Health Association)

218. The ultimate decision upon this issue rests with the Legislature of the Province of Ontario. It has the constitutional power under The British North America Act to legislate with respect to the fluoridation of municipal water supplies. There is no constitutional prohibition or limitation upon its legal powers in this field. We make this statement for two reasons. First, because many persons who appeared before us held the firm belief that the Supreme Court of Canada in the Forest Hill case (paragraph 4) had decided that fluoridation was illegal per se upon broad grounds involving the constitution or civil rights. These persons failed to appreciate the narrow issue decided by the Court. That case turned upon the interpretation of an Ontario statute and in their reasons the Supreme Court did not question the power of the Legislature to deal with this problem. As pointed

out in paragraph 5, the Legislature did in 1957 pass an act which permitted the continuance of fluoridation in eight Ontario municipalities. Our second reason for emphasizing the authority of the Legislature is that the opinion of the Committee upon the issue of civil rights is by no means a final and binding opinion. Our views are personal. At one stage in our deliberations we doubted whether we should express our views on the question of civil rights because the decision on this issue is peculiarly one to be made by the elected representatives of the people of this Province. However, we came to the conclusion that as civil rights was one of the most important and perhaps difficult aspects of the whole problem and as we had heard many sharply conflicting submissions with respect to it, we should not omit from our reports our considered opinion on it. In enunciating our conclusions and reasons for them, we are fully conscious, and somewhat relieved, that the final decision does not rest with us and that it is open for discussion and debate in public forums, at the meetings of municipal bodies and in the Legislature.

219. The opponents of fluoridation maintained that where a municipal water supply is fluoridated, then an inhabitant's freedom of choice - whether to drink fluoridated water or not - is removed. Against this contention, it was stated that any one objecting to drinking such water was free to obtain it from other sources such as wells or adjoining municipalities. In our opinion this choice is almost wholly illusory. In many large Ontario cities, it is illegal to dig wells and use water from them. Only a very small proportion of the inhabitants of Ontario cities would, because of location of their homes and their financial position, be in a position to provide themselves with water from sources other than their municipal supply. We, therefore, will consider the civil rights question upon the assumption that where fluoridation is introduced, there the inhabitants have no practicable alternative to ingesting fluoridated water and there they are compelled to consume it.

220. It was argued that fluoridation is objectionable on the ground that it is compulsory mass medication and is, therefore, a serious interference with the relationship of a patient with his physician. We heard prolonged arguments with copious references to dictionaries giving the various meanings of the words "drug", "poison",

"nutrient", "medicine" and "medication". On one side, it was strenuously contended that fluorides added to water were nutriments and not a medicine because they did not cure or alleviate dental caries but merely prevented them or lessened their incidence. From the opposing witnesses, we learned that "medication" means the administration to the body of anything which may prevent as well as cure disease. In our opinion, the important issue of civil rights does not fall to be decided by dictionary definitions. In these days, among the arts of persuasion is the common practice of describing a complicated and perhaps little understood state of facts with catching phrases or labels which carry with them implications not justified by the true state of the facts they are intended to describe. The issue we are now considering is not a mere matter of semantics or labels. To call fluoridation "mass medication" or to deny that it can be so described does not assist us in our quest of a solution of the problem. Such an approach only confuses the issue and tends to obscure the true nature of the facts with which we must deal and upon which we have earlier in this Report made findings.

221. We have described the effect of ingesting water to which has been added a fluoride compound in the recommended strength and have found that it benefits the tooth structure of children which benefit continues into adult life and that the ingestion of fluoridated water does no harm to the bodily system of persons of any age. Many water supplies contain naturally an effective concentration of fluoride; the process of fluoridation merely elevates to the recommended level those waters which are deficient in this natural constituent. We do not agree that the sacred relation of a patient to his physician is in any way involved in this process. The children will benefit almost immediately; no person will be in any way adversely affected by it.

222. In our view, the issue is simply this - is any organ of the State morally justified in compelling at the present time a proportion of the inhabitants of a particular community to ingest fluoridated water from which they may not derive any immediate benefit, in order to insure that another group in the community, the children, will have better teeth with the result as time passes the benefit will enure to an increasing proportion of the population?

223. This statement of the issue does not provide the answer to the problem which, although it is a narrow one, is crucial. For its solution we must probe and assess to the best of our ability what we consider to be the permissible limits of state action.

224. The adjustment between the individual's rights and the exercise of the state's power is a constant and laborious process. Throughout recorded history, it has engaged the close attention of theologians, philosophers and lawyers, and in more modern times the deep interest and scrutiny of political scientists, statesmen and politicians. No simple formula has ever been evolved which when applied to the recurring conflict would solve any current dispute with universal satisfaction. Each issue which becomes a matter of public urgency must be met and resolved.

225. Many of the submissions made to us assumed the existence of certain fundamental rights which enjoyed complete immunity from state action. To assess fairly and properly the validity of this assumption we must consider the true nature of civil liberties or rights. One of the most important theories underlying this conception was enunciated by the English philosopher John Locke in the Seventeenth Century. He maintained that the individual possessed certain innate and indefeasible rights which were vested in him by natural law and that the true function of the State was to protect and preserve those rights. However, it must not be assumed that there is a complete antagonism between the State and the individual. The State has a definite interest in the preservation of the individual's liberties and its intervention is required to limit their free exercise where they conflict with similar rights claimed by other individuals and the interest of society as a whole. The importance of Locke's theory for our present purpose lies in the fact it does provide a philosophical support for the opponents of fluoridation. The fallacy of his theory lies in its assumption of the coincidence of individual freedom with the greatest public good and for this reason it has not for over a hundred and fifty years had the support of responsible thinkers in this field.

226. In this country and in most parts of the British Commonwealth, the civil rights of the citizen are not guaranteed by any constitutional document. Apart from the specific rights mentioned in Magna Carta, The Habeas Corpus Act, the Act of Settlement and other statutes, our rights are to be found in the unwritten common law. Broadly speaking they are not defined in positive terms; the concept of such rights is a negative one in that any interference with the citizen's freedom is illegal unless it can be justified by some statute or rule of common law. It is important to note that none of the recognized civil rights or liberties are absolute and unqualified. For example, one of the most basic rights - freedom of speech - is limited by laws imposing penalties for sedition, blasphemy, obscenity and criminal libel and providing civil remedies for defamation. Restrictions and qualifications upon the free exercise of any right are essential for the purpose of protecting vital community interests and, in the final analysis, the civil rights themselves. Under our system of government these rights are not placed beyond the control of the Legislature which can from time to time modify or alter them. Although the Legislature is sovereign, nevertheless it does not except in emergencies such as war, enact legislation which abrogates those liberties of the citizen which are generally regarded as vital and the limits of which are usually in practice well recognized and have the support of informed public opinion to which the Legislature is responsive. However the last hundred years have shown that the public have expected, in fact, demanded that the State assume increasing responsibility for functions hitherto left to private initiative and responsibility. The action of the State in this direction has, of course, diminished the citizens' area of freedom but this has been done with the approval of the public opinion.

227. Locke's theory was reflected, towards the end of the Eighteenth Century in the First and Fourteenth Amendments to the United States Constitution. The practical impossibility of per - mitting the unqualified enjoyment of the rights and freedoms specified in those Amendments, compelled the Supreme Court of that country to declare in numerous cases that these rights were not absolute but were subject to reasonable regulation by the legislature in the public interest. Pertinent examples of this inter- pretation are the decisions of the American courts in cases in which municipal ordinances authorizing fluoridation of water supplies were attacked by the contention that they were a denial of the individual's

civil rights guaranteed by the Constitution. In every instance the Courts rejected that contention and upheld the impugned ordinance. Upon four occasions the Supreme Court of the United States refused to review the decisions of the lower courts (Appendix XII). We refer to these cases not because they are decisive of the issue facing this Committee but to show that civil rights even though embodied in a written constitution binding upon the Legislature are not absolute but on occasion can and sometimes must be limited and qualified in the public interest. Notwithstanding the different forms in which civil rights are expressed and defined the recognition and necessary modification of them is approximately the same in both Canada and the United States.

228. In only one brief was the submission made that fluoridation encroaches upon the freedom of religious worship. This freedom, touching as it does deep human feelings, was won in most countries after much travail and it should be at all times jealously guarded. A pre-Confederation statute passed in 1852 by the Parliament of the Province of Canada provided "the free exercise and enjoyment of Religious Profession and Worship, without discrimination or preference, so as the same be not made an excuse for licentiousness or a justification of practices inconsistent with the peace and safety of the Province is by the constitution and laws of this Province allowed to all Her Majesty's subjects within the same". This statute is in force in Ontario today. (Rectories Act, R.S.O. 1897, c. 306, s. 1.) The concept of religious freedom includes liberty of conscience and belief and the freedom to worship and to propogate religious doctrines and perhaps little else. These accepted practices must be distinguished from the extension of religious bans and fiats into the area of the common life of the community as a whole. Members of religious bodies in this country have been uniformly unsuccessful by appealing to their sincerely held beliefs in obtaining exemption from laws imposing upon the public the duty of providing necessaries of life, including medical treatment for those in their care and laws requiring their children to attend school. No group can be conceded on the ground of its religious beliefs the right to withhold from the great majority of the public a benefit it desires. The fact that municipal water is fluoridated in no way prevents the exercise of religious liberty as commonly recognized. It does not require any one to believe or to profess to belief, in the efficacy of fluoridation. If any particular religious exercise, such as prayer, is the only

true route to health, that route remains as open to those who believe it as it was before the water was fluoridated.

229. Except in the eight Ontario municipalities in which the continuance of fluoridation has statutory authority, there is at present no legal justification for fluoridation. In this limited sense to fluoridate municipal water would under existing legislation be a denial of a civil right on the short ground that there is no legal authority for it.

230. Because no civil liberty is absolute, any claim to its full recognition must be assessed and weighed against the contrary interests of individuals denying the claim and the interest in the broadest sense of the community and society. The legislature must assess and balance the interests involved. We will now proceed to the conflicting interests as we see them in this particular issue of fluoridation upon the assumption of the validity of our findings summarized in paragraph 216.

231. The opponents argue that fluoridation is an unwarranted interference with an individual's right to the inviolability of his body; that the individual's right to decide what shall be done with or to his body is one of the most fundamental liberties. This, of course, is not so in the Province of Ontario. Such a right to bodily integrity is recognized by law only to the extent that it is not qualified by statute. The freedom of the person protected by common law and numerous statutes is, broadly speaking, the individual's right to be unrestrained except in accordance with law and was proclaimed as a protection against arbitrary arrest and detention. Interference with bodily integrity, apart from lawful restraint and punishment, has become a political and social problem only in recent years. The rapid increase in medical knowledge and the growth in responsibilities of public health administration has brought the problem to the fore. Public opinion now accepts and demands the continuance of such compulsory public health measures as the chlorination of drinking water, pasteurization of milk, vaccination and the treatment of venereal diseases, to mention only a few. The compulsory feature of these and similar measures is justifiable upon the evident ground that they prevent the onset and

spread of contagious diseases and so protect the health of the individual. As dental caries is not contagious, these established interferences with the human body do not in themselves by way of example or precedent, provide a justification for fluoridation. The only precedent of compulsory treatment of a food product to prevent or lessen a non-contagious disease to which we were referred was the regulation made in 1949 under The Dominion Food and Drug Act which prohibits the sale in Canada of salt for table or general household use unless it is iodized, (S.O.R./49/546).

232. We have advanced a long distance from the point of time when the primary and only function of the State was to preserve law and order. It is unnecessary to trace in this Report the development and vast increase in the functions of government. The growing complexity of modern life and the public demand for social justice in its broadest aspects have required the increasing intervention of the State This has been evident particularly in the field of public health. The resources of governments in scientific information and the agencies to apply it are rapidly increasing. Governments possess constantly increasing statistical records which they can and do employ to assess the advantages of providing for the public the benefits of scientific discoveries.

233. Elected bodies who are sensitive reflectors of public opinion, accept today responsibility for the protection and improvement of the physical and mental welfare of the citizens particularly of those who are under such disabilities as infancy, old age and disease.

234. Fluoridation of water will, as we have found, reduce the incidence of dental caries which is a serious disease suffered by the vast majority of the population causing them pain, nuisance and expense and often does affect other organs of the body. Fluoridation will improve the dental health and thus the general health of an increasing proportion of the population.

235. The group to be immediately benefited are the children. As a group they are severely handicapped in any initiative

for protecting their own health and their own teeth. Unless communal water supplies are fluoridated, the children's access to the benefits of fluorides depends upon the knowledge, thought and care of their parents. For the most part the children least likely to have a high degree of parental care are those in poor or shiftless families - those children who will grow up with the severest handicaps of other sorts.

236. Fluorides add no taste or odour to the water. The ingestion of fluoridated water is harmless to physical health or bodily vitality. The only objection to it lies in the mental perturbation of those who are compelled to consume it against their will. Upon this point, it should be stated that practially no one from any of the eight Ontario municipalities which are now fluoridating their water objected to it on this ground as a breach of their civil rights or in fact upon any other ground.

237. It was argued that if fluoridation were permitted, this would provide a precedent for the addition of other agents into the water. This is the "thin edge of the wedge" argument which is often advanced when all other objections fail against innovations which have been found by careful examinations and tests to be beneficial to the community. In one sense fluoridation would be a precedent but it has been thoroughly investigated not only in Ontario but in many other parts of the world and it will be introduced only after a vote of the Legislature. We are entitled to assume that any other ventures for which fluoridation might be offered as a precedent, would be subjected to the same careful scrutiny and control through the operation of our democratic processes. Our duty as a Committee is to consider this specific question of fluoridation and does not extend beyond that.

238. If fluoridation were introduced, the range of the individual's freedom to exert his mind and body in his own interests, to communicate his ideas and to combine with others in lawful pursuits would not be affected or curtailed. If the Legislature authorized fluoridation in the exercise of our democratic process, the objectors will of course be disappointed but they will be free

to renew this argument by speech, pamphlets and public meetings with the hope that the Legislature might be persuaded at a later date to alter its decision.

239. After carefully weighing the foregoing considerations we have reached the conclusion that the fluoridation of municipal water supplies by the authority of appropriate legislation would not be a denial of any fundamental or basic civil right or liberty which the Legislature in its wisdom should seek to preserve.

PART XI

RECOMMENDED LEGISLATION

240. We have given careful consideration to the general character of the legislation which should be enacted in the event the Legislature of Ontario decides to authorize the fluoridation of municipal water supplies.

241. In most localities a water supply system does not provide water over a large area covering many municipalities. Subject to what we say in paragraphs 246 and 247, water supply is a service over which the local municipalities have had and still have a direct and fairly complete control. This situation should, in our view, continue as long as it is practicable in any municipality.

242. We are mindful of the important fact that fluoridation is a controversial issue which has aroused strong emotional feelings among both its proponents and opponents. Although this Committee has no doubt that fluoridating municipal water supplies is the best method of conferring this beneficial measure upon the public, nonetheless we recognize the existence of sincerely held opinions to the contrary. The opposition to it, we feel, will diminish with the spread of the knowledge of its great value as has been the case with opposition in the past to other public health measures of proven value.

243. It is unlikely that public opinion upon the issues involved in this subject is uniform throughout the Province. For this reason we recommend against the enactment of legislation which would compel municipalities to fluoridate their water supplies at this time. Where opinions are held, they are divided. We suspect that a large proportion of the population has no particular views. The education of the public in this subject would be more effective at the local level where it would be more feasible to form an intelligent public opinion upon the proper solution of this problem.

244. With these considerations in mind, we recommend that the legislation be permissive in form by empowering the municipalities to introduce fluoridation.

245. In the past few years, some municipal councils have taken the opinions of their voters on this issue by holding a referendum; others have acted directly by by-law; and still others have introduced fluoridation without referendum of by-law. Notwithstanding the provisions of section 5 of The Public Health Amendment Act, 1957 (Appendix II), we are strongly of the opinion that this issue should not be decided at the local level by referendum. Many aspects of this problem are highly technical and bristle with apparent scientific complexities. It bears no resemblance to such municipal issues as Sunday sports and entertainment. Municipal councils before coming to a decision, can without difficulty, obtain expert advice. They would act, we are convinced, with care and due regard for the public opinion prevailing at that time among their citizens. This Committee has taken almost two years in the investigation of this problem and during that time has had the assistance and advice of scientifically qualified persons, some of whom supported and others of whom opposed fluoridation. If the issue in any municipality were to be decided by referendum, then most of the voters would have to make their individual decisions perhaps upon inadequate and misleading information. It is the type of issue which, in our opinion, municipal councils should take the responsibility of deciding and should not be required to take a vote of their inhabitants before acting. We, therefore, recommend, that the legislation should empower municipalities to introduce fluoridation by by-law without the necessity of a referendum.

246. The preceding recommendations in this Part have reference only to waterworks systems owned and operated by municipalities and their public utilities commissions. There are still operating in Ontario company public utilities which supply water to municipalities under contract. Also, some settled localities have no municipal organization because they are townsites owned and managed by companies. Legislation authorizing fluoridation of water supplies should provide methods of deciding the issue for such municipalities and localities.

247. The Ontario Water Resources Commission has by its statute (Statutes of Ontario, 1957, c. 88 and amendments) very wide powers of supervision over municipal water systems. It has the power, which it is exercising upon an increasing scale, of constructing and operating systems of water supply which serve more than one municipality. In the foreseeable future the operations of this Commission will be vastly extended, particularly in southwestern Ontario, where it will probably supply water to large populations living in many municipalities. In such areas the control of local municipalities over their water systems will diminish and in many instances will completely disappear. Our recommendations in this Part are not applicable to municipalities where the supply of water is not a local government function. The decision with respect to fluoridation for those localities whose water systems are under the direct control of the Commission may perforce have to be made by that body.

PART XII

SUMMARY OF

CONCLUSIONS AND RECOMMENDATIONS

248. The Committee has unanimously reached these following conclusions:

i We are convinced that the incidence of dental caries in Ontario is of such magnitude that it must be regarded both as a serious and as a major public health problem and that adequate treatment of dental caries in the whole population is beyond the resources of the dental profession.

ii We are also convinced that the treatment of dental caries alone will not control or reduce the ultimate incidence of tooth decay.

iii We realize the importance of good oral hygiene but at the same time recognize the limitations of a good oral hygiene programme in our society.

iv We also realize the importance of proper nutrition in the reduction of the incidence of dental caries but acknowledge, with some degree of astonishment and with much concern, the inadequacy of our over-all nutrition in Ontario.

v We firmly believe that the reduction of the incidence of dental caries is a problem of prevention, not one of treatment.

vi We are convinced that it has been conclusively proved that the presence of fluoride, either naturally occurring or mechanically added in a municipal or communal water supply in concentrations of approximately one part per million strikingly reduces the incidence of dental caries when such water is consumed during the period of tooth development and that the caries-reducing

effect of fluoride extends into adult life.

vii We are also convinced that the long-term ingestion of fluoride at approximately one part per million over a very wide range of water intake is not harmful to bodily health and that no fluorosis of esthetic significance is specifically associated with it.

viii We are satisfied that the equipment in use in municipal water systems for the addition of fluoride to the water supply is mechanically adequate for this purpose and that the concentration of fluoride is and can be controlled within the limits of optimal effectiveness and safety.

ix We are also satisfied that the presence of fluoride in the recommended concentration does not cause corrosion of water mains, pipes and fittings nor does it affect adversely in any way industrial processes.

x We find that the cost of fluoridating a municipal water supply is very reasonable in relation to the health benefit to the community.

xi We believe that at the present time there is no practical alternative to the fluoridation of municipal water supplies in those areas where the water does not contain approximately one part per million of fluoride.

xii We hold the firm opinion that the fluoridation of municipal water supplies by the authority of appropriate legislation would not be a denial of any fundamental or basic civil right or liberty which the Legislature of Ontario should protect and preserve.

249. The Committee unanimously recommends:

i that legislation be enacted empowering municipalities to fluoridate their water supplies;

ii that such legislation should authorize municipalities

to introduce fluoridation by by-law without the necessity of a referendum;

iii that legislation be enacted authorizing the fluoridation of water supplies which are not controlled or operated by municipalities;

iv that the appropriate departments of the Ontario Government should keep under constant review alternatives to fluoridation of municipal water supplies which may prove feasible for people living in areas not served by communal water systems;

v that a sound, concerted programme supplying accurate nutritional information to the people of Ontario as part of a total programme of general health and dental health education, be implemented.

ACKNOWLEDGMENTS

It will be evident from even a cursory reading of the foregoing Report that the Committee received assistance from many persons and organizations in the course of its investigations.

We first mention those who filed briefs. Much thought and labour had obviously been devoted to their preparation. The briefs were a great help to us in formulating the issues and in providing references to published material dealing with these issues in their broad as well as detailed aspects.

The witnesses who appeared at the public hearings and took an active and at times a strenuous part in presenting their views and attacking the contrary evidence by searching questions are to be commended for their public spirit. Many witnesses who came from a distance and remained in Toronto throughout the public sessions of the Committee did so at their own expense.

We wish to express our gratitude to Doctors E. W. McHenry, E.A. Sellers, Carol Buck, R. M. Grainger, G. Nikiforuk and K. J. Paynter. They furnished us with very complete and useful reports which gave us the essential background material for our investigation. They performed a valuable service for which they were content to accept nominal honoraria. At the public hearings their reports were attacked by some witnesses upon the ground that these experts were unfairly biased in favour of fluoridation and should not have been chosen by the Committee for reports upon any segment of this controversial problem. When we selected them, in fact until we received their reports, we did not know their views on the fluoridation question. After considering the material they gave us, and their explanations for their opinions which they gave under, in some instances, incisive questioning, we decided that the accusations levelled against their intellectual and scientific integrity were completely devoid of substance.

Our sincere thanks are due to Doctors F. B. Exner, A. A. London, C.A. Brusch and G.L. Waldbott, all of whom are professionally qualified gentlemen, practising in the United States and who are vigorous opponents of fluoridation. Many lay witnesses in their briefs and in their evidence referred us to the

published opinions of these experts. It was, therefore, with deep interest we heard their views and their reasons for them from their own lips and heard their evidence tested by cross-examination. This was of the utmost value to the Committee when it came to make its findings. The fact that we did not adopt their views in no way reflects upon the skill and sincerity with which they advanced them or detracts from the real assistance they gave us.

We also acknowledge the help we received in interviews from Dr. H. K. Brown, Dr. G H. Josie, and Dr. A. E. Berry upon matters within their particular spheres of work and interest. We are specially grateful to Dr. W. G. Senior, who willingly gave us some of his valuable time in the course of a busy trip to this continent.

In addition to the reports mentioned in the Introduction, we received a helpful study from Dr. E. W. McHenry and one jointly prepared by Dr. Carol Buck and Dr. A. H. Sellers, the Director of the Division of Medical Statistics in the Ontario Department of Health. These studies are listed in Appendix XIII. The value of these studies lay in their confirmation of opinions we had been given on vital aspects of our problem.

We are indebted to many others who assisted us by answering questionnaires sent out by the Committee and in this group we thank specially, medical officers of health and managers of public utility commissions.

Throughout our work we have had the ready assistance of Dr. M. B. Dymond, the Minister of Health, and of his officials. Every request we made for help in our work was quickly granted.

Finally, we record the valuable assistance and comfort given to us by Mr. Donald R. Richmond, our secretary, and Mr. Austin M. Cooper, our counsel. They were intimately associated with the Committee in its work and at all times discharged their duties in a cheerful and able manner.

I

(Crest of Ontario)

EXECUTIVE COUNCIL OFFICE

Queen's Park
OC - 835/59

Copy of an Order-in-Council approved by His Honour the Lieutenant-Governor, dated the 17th day of March, A.D., 1959.

Upon the recommendation of the Honourable the Prime Minister, the Committee of Council advise that pursuant to the provisions of The Public Inquiries Act, R.S.O. 1950, Chapter 308,

The Honourable Kenneth Gibson Morden,

a Justice of the Court of Appeal of
The Supreme Court of Ontario,

Dr. George Edward Hall,

President of The University of
Western Ontario,

and

Mrs. Egmont L. Frankel,

be appointed to inquire into, examine, and report from time to time upon, all matters in any way pertaining to fluoridation of public water supplies.

The Committee further advise that they shall have the power of summoning any person and requiring him to give evidence on oath and to produce such documents and things as by them are deemed requisite for the full investigation of the matters into which they are appointed to examine.

And the Committee further advise that the Chairman of such inquiry shall be the said the Honourable Kenneth Gibson Morden.

Certified,

"H. A. Stewart"
Clerk, Executive Council.

Queen's Park
OC - 693/60

Copy of an Order-in-Council approved by His Honour the Lieutenant-Governor, dated the 11th day of February, A.D. 1960.

Upon the recommendation of the Honourable the Prime Minister, the Committee of Council advise that Order-in-Council numbered OC-835/59, dated March 17th, 1959, appointing certain persons under the provisions of The Public Inquiries Act, R.S.O. 1950, Chapter 308, to inquire into, examine, and report from time to time upon, all matters in any way pertaining to fluoridation of public water supplies, be amended by deleting the name of Mrs. Egmont L. Frankel, resigned, and appointing and substituting in her place and stead -

Mrs. Cameron McKenzie, Beaverton, Ontario.

Certified,

"J. J. Young"
Acting Clerk, Executive Council.

II

ONTARIO LEGISLATION

The Public Utilities Act, R.S.O. 1950, c. 320

"Sec. 12. The corporation may pass by-laws for regulating the time, manner, extent and nature of the supply by the works, the building or persons to which and to whom the water shall be furnished, the price to be paid therefor, and every other matter or thing related to or connected therewith which it may be necessary or proper to regulate in order to secure to the inhabitants of the municipality a continued and abundant supply of pure and wholesome water, and to prevent the practising of frauds upon the corporation etc."

The Municipality of Metropolitan Toronto Act, 1953, c. 73.

"Sec. 41. The Metropolitan Council may pass by-laws for regulating the time, manner, extent and nature of the supply of water from its waterworks systems, and every other matter or thing related to or connected therewith which it may be necessary and proper to regulate in order to secure to the inhabitants of the Metropolitan Area a continued and abundant supply of pure and wholesome water, and to prevent the practising of frauds in the Metropolitan Corporation with regard to the water so supplied."

"Sec. 56. Sections 2, 3, 4, 5, 13, 28, 31, 32, 33, 52, 53, 54, 56, and 57 of The Public Utilities Act shall apply mutatis mutandis to the Metropolitan Corporation."

The Public Health Amendment Act, S.O. 1957, c. 97.

"1. Section 1 of The Public Health Act is amended by adding thereto the following clause:

(d) 'fluoridation system' means a system comprising

equipment and materials established for the addition of a chemical compound to release fluoride ions into a municipal water supply."

"5. The Public Health Act is amended by adding thereto the following sections:

FLUORIDATION

75a. Every municipality named in Schedule C shall be deemed to have had authority to establish and operate its fluoridation system and shall be deemed to have all such powers as may be necessary to maintain its fluoridation system.

75b. (1) Any municipality named in Schedule C may at any time discontinue its fluoridation system or may at any time submit the question set out in subsection 2 to a vote of the electors of the municipality at the next municipal election, and, if a petition signed by 10 per cent or more of the total number of persons whose names appear on the last revised voters' list of the municipality as being qualified to vote at the municipal elections requesting the council to submit the question set out in subsection 2 is filed with the clerk of the municipality, the council shall submit such question to a vote of the electors at the next municipal election.

(2) The question referred to in subsection 1 is:

Are you in favour of the continuation of the fluoridation of the public water supply in this municipality?

(3) Where a majority of the persons referred to in subsection 1 vote in the negative, the municipality shall thereupon discontinue the fluoridation system."

"9. The Public Health Act is amended by adding thereto the following Schedule:

SCHEDULE C

(Sections 75a, 75b)

MUNICIPALITIES

1. City of Brantford
2. Town of Brockville
3. Improvement District of Deep River
4. Town of Fort Erie
5. City of Oshawa
6. Town of Thorold
7. Township of Tisdale
8. City of Sudbury"

III

MEMORANDUM

SETTING UP AREAS OF RESEARCH TO BE UNDERTAKEN BY THE ONTARIO FLUORIDATION INVESTIGATING COMMITTEE

(I) The Ontario Fluoridation Investigating Committee has been recently established by the Government of the Province of Ontario. Its purpose, amongst other things, is to ascertain the efficacy, if any, of fluorides in the prevention of dental caries. The chief method of using fluorides to this end has been through the fluoridation of municipal or other water supplies to provide a concentration of approximately 1 p.p.m.

(II) It is necessary, therefore, to ascertain the facts, insofar as they are presently known, relative to this whole question. The Committee wishes, at this time, to obtain analytical reports based upon scientific publications, on various aspects of this subject:

1. An assessment of the pharmacological, physiological, and pathological effects of fluorides at various concentrations on the mammalian body with special reference to concentrations from 0 to 10 (approx.) p.p.m. as may be found naturally or effected by the addition of fluorides in water supplies, including cumulative effects.

2. The differences, if any, in the various effects of fluorides occurring naturally in water or in foodstuffs and fluorides which have been added to water supplies or foodstuffs.

3. Considering that there are many "trace elements" which occur naturally and which may or may not be "toxic" in larger concentrations, an evaluation is required of such "trace elements", their significance in health and in disease, the inclusion and concentration of "trace elements" as supplements

or reinforcements in various prepared foods and the reasons for so doing, and the effects on the body of such "trace elements" at various levels up to toxic concentrations.

4. Those elements or compounds which are necessary for normal nutrition but which, in different compounds or in high concentrations, are actually used commercially as poisons (see also No. 3).

5. The concentration of fluorides occurring naturally in water supplies in various geographical locations and any proven differences in the morbidity, mortality or other features of health or disease of the people in the various areas relative to the concentration of fluorides.

6. The ability of an individual to ascertain by taste, smell, or by any other sensory system, the presence or absence of various "trace elements", including fluorides, in water, milk, or other vehicle.

7. Epidemiological, statistical, or other planned and controlled surveys and experiments which have been undertaken to prove or disprove that fluorides in various concentrations have an influence on the teeth, on the incidence of dental caries and any other disease process in the oral cavity.

8. The influence of fluorides at various concentrations, as well as in various forms, on sound teeth as well as on the prevention of dental caries at various ages.

9. The incidence of dental caries in various age groups in different geographical areas, in general, irrespective of fluoride content of water.

10. The vehicles which are presently used for the ingestion of various elements necessary for normal health but which in certain areas are naturally absent or present in inadequate amounts.

(III) In dealing with the above phases of this question, other relevant points impinging on the items listed would of certainty be encountered. It would be expected that such points would be included in the reports.

(IV) From a completely different point of view, information on the following points will be required:

1. Have any municipalities with a relatively high fluoride concentration in their natural water supply ever attempted, or felt the need of attempting, to reduce the fluoride content of their water and if so, why, and were they successful or not?

2. Are there any other elements or chemicals found naturally in food or water in concentrations which in other areas might be considered to be at toxic or near toxic levels? If so, what are they, what are the effects, etc.?

3. Under what conditions did the various municipalities presently adding fluoride to their water supply do so - by referendum, by municipal council authority, etc., and what degree of pre vote or decision mass education took place and under what auspices?

4. On what basic principles, relative to "civil rights" were the following measures put into effect or imposed?

   (a) compulsory pasteurization of milk in Ontario

   (b) compulsory chlorination of municipal water supplies in Ontario

   (c) compulsory vaccination for re-entrance

to Canada, even of Canadians, who have been in Europe, etc.

(d) the "iodization" of table salt

(e) vitamin enrichment of various foodstuffs

(f) any other relevant or comparable measure to the above 5 items

5. Since a proportion of the people in the Province of Ontario are for one reason or another apparently in favour of fluoridation of water, being convinced of the efficiency of added fluorides as a means of influencing the incidence of dental caries, and since there is a proportion of the people apparently opposed to fluoridation of water are there other vehicles for added fluorides so that those wishing to purchase "fluoride" enriched foods or other materials might do so, with special reference to foodstuffs consumed regularly by the age groups most susceptible to dental caries?

(V) The above is simply a brief resume of some of the points the Committee wishes to consider.

IV.

(Crest of Ontario)

ONTARIO FLUORIDATION

INVESTIGATING COMMITTEE

This Committee was appointed by Order-in-Council 835/59, pursuant to the Public Inquiries Act, R.S.O. 1950, Chapter 308, to inquire into, examine and report from time to time upon all matters in any way pertaining to fluoridation of public water supplies.

The Committee will hold public hearings in Committee Room No. 2 at the Parliament Buildings, Queen's Park, Toronto, commencing on Monday, May 2nd, 1960, at 11 o'clock in the forenoon, daylight saving time, for the purpose of discussing, considering, and hearing representatives upon the written submissions made to the Committee.

All persons who desire to make any submission within the scope of this inquiry are requested to deliver five copies of their briefs to the Secretary on or before March 15th, 1960.

Dated at Toronto this 27th day of January, 1960.

D. R. Richmond,
Secretary of the Committee,
315 Treasury Building,
Queen's Park,
Toronto 2, Ontario.

The above notice was published in the following daily newspapers:

Barrie Examiner
Belleville Ontario-Intelligencer
Brantford Expositor
Cornwall Standard-Freeholder
Fort William Times-Journal
Galt Reporter
Guelph Mercury
Hamilton Spectator
Kenora-Keewatin Daily Miner & News
Kingston Whig-Standard
Kirkland Lake Northern Daily News
Kitchener-Waterloo Record
Lindsay Post
London Free Press
Niagara Falls Review
North Bay Nugget
Orillia Packet & Times
Oshawa Times
Ottawa Citizen
Ottawa Journal
Owen Sound Sun-Times
Pembroke Observer
Peterborough Examiner
Port Arthur News-Chronicle
Brockville Recorder & Times
Chatham News
Port Hope-Cobourg Guide
St. Catharines Standard
St. Thomas Times-Journal
Sarnia Observer
Sault Ste. Marie Star
Stratford Beacon-Herald
Sudbury Star
Timmins Daily Press
Toronto Globe & Mail
Telegram
Star
Welland-Port Colborne Tribune
Windsor Daily Star
Woodstock Sentinel-Review

V

NEWS RELEASE

TORONTO, January 27:- Public hearings will open in Toronto on May 2nd on the question of fluoridation, Mr. Justice Morden, Chairman of the Ontario Fluoridation Investigating Committee, announced today.

The Committee set up last year by the Government of Ontario has to date received detailed studies from well qualified medical, dental, nutritional and pharmacology experts from across the province.

It is hoped, according to Mr. Justice Morden, that all interested persons and organizations will take the opportunity of filing briefs for the public hearings and appearing before the Committee when submissions and representations made will be fully discussed and considered.

Hearings will be held in Committee Room 2 in the main Parliament Buildings at Queen's Park.

Prior to May 2nd, those who have filed briefs and who intend to appear will be notified of the order in which the different aspects of the problem will be considered.

The Committee is now in a position to hold public hearings as most of the very extensive reports of the experts retained have now been compiled and submitted.

Any person or organization wishing to air their views at the hearings is required to submit a written outline by March 15th. Briefs should be submitted to D. R. Richmond, Committee Secretary, 315 Treasury Building, Queen's Park, Toronto.

It is expected that a large number of individuals and organizations from across the province will appear at the hearings.

VI

LIST OF BRIEFS

1. Citizens Health Committee,
Ottawa.

2. Dr. F. B. Exner,
Seattle, Washington.

3. Mr. Louis Salapat,
Niagara Falls.

4. Mr. Paul Geymonat,
Ottawa.

5. Mrs. Irene Lefebvre and Mr. G. Lefebvre,
Ottawa.

6. Mr. J. C. Rostitter,
Ottawa.

7. Mrs. Bertha Fraser,
Toronto.

8. Mr. W. C. Coupland,
Rexdale.

9. Mr. J. H. Hunt,
Ottawa.

10. Mr. J. L. Howland,
Ottawa.

11. Mr. Alexander B. Davies,
Hamilton.

12. Mr. and Mrs. J. C. Martin,
Guelph.

13. Local Board of Health of Ottawa.

14. Christian Science Committee on Publication
for Ontario, Toronto.

15. Academy of Dentistry,
Toronto.

16. Mrs. William Paterson,
Riverside.

17. Miss Doris H. Currie,
Ottawa.

18. Ontario Medical Association,
Toronto.

19. Department of Nutrition,
University of Toronto.

20. Mr. L. Clarence Boyle,
Toronto.

21. The Brockville Pure Water League.

22. Northern Ontario Dental Association,
Sudbury.

23. Henry M. Bloom,
Ottawa.

24. Mr. G. G. Kew,
Riverside.

25. Mrs. Elmer Muldoon,
Ottawa.

26. Property Owners Association of Ottawa.

27. Mr. Geoffrey E. Radcliffe,
Kingston.

28. Citizens Health Association,
St. Boniface, Manitoba.

29. Mr. Roger E. Vallee,
Cornwall.

30. Mr. F. Clifford,
Ottawa.

31. Sudbury and District Dental Society.

32. Mr. E. M. Hewitt,
Ottawa.

33. Mrs. Beatrice C. Gow,
Ottawa.

34. Mr. W. M. Lever,
Ottawa.

35. Mr. L. P. Cyrenne,
Sudbury.

36. Windsor and District Safe Water Association.

37. Mr. Edgar V. Gilbert,
Ottawa.

38. Canadian Federation of Property Owners,
Toronto.

39. Miss L. Gauthier,
Ottawa.

40. Lord Douglas of Barloch,
London, England.

41. Health League of Canada,
Toronto.

42. Canadian Dental Association,
Toronto.

43. Canadian Public Health Association,
Toronto.

44. Mrs. F. D. Richardson,
Ottawa.

45. Ottawa Citizen's Committee for Fluoridation.

46. Mr. and Mrs. E. Gagnon,
Ottawa.

47. Mr. Wilfrid Butterworth,
Kitchener.

48. Mrs. G. G. Smith,
Ottawa.

49. Mr. Wm. L. Farmer,
Ottawa.

50. Mrs. M. Cummings,
Ottawa.

51. Mrs. Ethel Main,
Ottawa.

52. Mrs. A. W. Smith,
Ottawa.

53. Mr. W. G. Smith,
Ottawa.

54. Mr. G. G. Smith,
Ottawa.

55. Mrs. J. Farmer,
Ottawa.

56. Pure Water Committee of Ottawa.

57. Mrs. Marion L. McIntosh,
Toronto.

58. South Walkerville Citizens' Safe Water
Committee.

59. Sudbury Citizen's Health Committee.

60. Mrs. Lionel Lefebvre,
Ottawa.

61. Lakehead Pure Water Association,
Fort William.

62. Pure Water Committee of Kingston.

63. Mr. J. C. D. D'Esterre,
Kingston.

64. J. M. Bellhouse, Reg. N.,
Kingston.

65. Dominion Fluoridations Ltd.,
Toronto.

66. The Royal College of Dental Surgeons
of Ontario, and
The Ontario Dental Association,
Toronto.

67. Citizen's Health Association,
Toronto.

68. Dr. W. J. McCormick,
Toronto.

69. Mr. David S. Christie,
Ottawa.

70. Mr. Stewart Ford,
Ottawa.

71. Mrs. R. H. Welsh,
Hamilton.

72. Pure Food Guild of B.C. Inc.,
Vancouver, British Columbia.

73. Dr. Wm. A. Costain,
Toronto.

74. Mrs. J. de Bellefeuille,
Ottawa.

75. Mrs. Roseanna Lafontaine,
Ottawa.

76. Pure Water Committee of Kingston,
Kingston.

77. Progressive Conservative Business
Women's Club,
Ottawa.

78. Mr. Henry W. Mason,
Ottawa.

79. Mr. F. D. Richardson,
Ottawa.

80. Mr. J. F. McAlpine,
Ottawa.

81. Mrs. M.H.W. Cameron,
Ottawa.

82. Property Owners' Association of Toronto.

83. The University Women's Club of Ottawa.

84. Mr. F. F. Fatt,
Ottawa.

85. Academy of Medicine,
Toronto.

86. Mrs. B. B. Coldwell,
Ottawa.

87. Mrs. J. H. Cathcart,
Ottawa.

88. Dr. G. L. Waldbott,
Detroit, Michigan.

89. Mrs. George L. Waldbott,
Grosse Pointe Park, Michigan.

90. Mrs. R. V. Lester,
Ottawa.

91. Ontario Public Health Association,
Toronto.

VII

MEMORANDUM OF PROCEDURE
ONTARIO FLUORIDATION INVESTIGATING COMMITTEE

In response to its public notice, the Committee has received 91 briefs which have all been read.

The Committee will hold public hearings in Committee Room No. 2 of the Parliament Buildings, Toronto, commencing on Monday, May 2nd, 1960, at 11 a.m. Daylight Saving Time. These hearings will continue on consecutive days, except Saturday and Sunday, and it is expected that they will be completed at the latest by May 13th.

The Committee has divided the broad subject of fluoridation of municipal water supply into the following topics:-

I. The effectiveness of fluoride in reducing the incidence of dental caries

It is necessary, in the very first instance for the Committee to establish the efficacy or otherwise of fluoride, within certain concentrations, in reducing the incidence of dental caries. Upon this point all other considerations rest. Consideration will therefore be given in this session to such topics as:

i the mechanism of action of fluorides in the prevention of dental caries

ii the relation between fluorides in water and dental caries

(a) naturally occurring fluorides
(b) controlled added fluorides

iii fluorides in vehicles other than water and their relation to dental caries

iv other relevant aspects of the relation of fluorides to oral hygiene

II. i The role of "trace" elements in metabolism and nutrition and with special reference to fluorides

The Committee wishes to give consideration to the so-called trace elements, their role in the body and the effects of low, optimal, and excessive amounts of these elements in the body, and whether or not there is a "safe" or optimal level of fluoride intake. Such topics as the following will be considered:

(a) trace elements in nutrition

(b) toxicity, or otherwise, of these same elements when taken in excessive amounts

(c) the occurrence of fluorides in foods, etc.

ii Oral hygiene - nutrition, dental care, etc.

III. Pharmacological, physiological and pathological effects of fluorides on the mammalian body

The Committee wishes to evaluate the results of the many experiments, observations, and other data relative to the acute and chronic effects upon living mammalian tissues of varying concentrations of fluoride. Consideration will therefore be given in this session to such topics as:

i fluoride metabolism

ii influence on special organs and systems

iii acute and chronic toxicity

iv difference in effect of fluorides occurring naturally in water and fluoride added to water supply

v other aspects relevant to the main topic, allergy, etc.

The consideration given to this phase will be limited to the above.

IV. Epidemiological and statistical evidence of the effects of water-borne fluoride upon non-dental organs and processes

The Committee wishes, in the discussions of this phase of the problem, to have brought forth pertinent information relative to morbidity and mortality, as related to the intake of fluorides at various levels.

Such topics, therefore, as dealing with the following will be discussed:

i the possible medical effects of chronic exposure to fluoride

ii investigations of the medical effects of long-term ingestion of fluoride in water; general and with specific reference to disease states

V. Chemical, engineering and other features relative to the administration of fluoride and its control in municipal water supplies

The Committee wishes to consider in this phase the types of fluoride compounds used, the means used to insure "optimal quantities" being delivered into the system, the storage or reservoir factors, the constant control features, and the economics of the "added fluoride" method. Discussion will be sought also relative to the addition of fluoride in other vehicles.

Such topics as the following will be dealt with:

i the type of fluoride compound used

ii the practicability of fluoridating water supplies

iii the types of "plants" or system

iv tests and controls

v effects of fluorides on pipes, pumps, taps, etc.

vi other chemical, mechanical, or control considerations

vii portion of population served by municipal water supplies and relevant considerations

viii alternative means of supplying fluoride in water supplies

ix economic factors

VI. Personal rights of citizens

The Committee wishes to consider the significant question of personal rights, freedom of choice, compulsion or otherwise relative to the addition of chemicals and/or other agents or materials into a public water system. The moral, legal and philosophical implications of adding such materials to a municipal water system will be considered. Such topics as the following will be examined:

i relevant legislation and court decisions

ii "mass medication"?

iii infringement of personal rights?

iv compulsion by majority vote, authority of local administration, etc.

v other topics pertinent to "rights", freedom of choice, etc.

Evidence and representations upon each topic will be completed in the above order before the Committee passes to thenext topic on the list.

Those persons and organizations who have filed briefs are requested to notify the secretary, not later than Wednesday, April 27th, if they will be attending the public hearings. Due weight and consideration will, of course, be given to the contents of all briefs

whether the persons who filed them appear or not.

Mr. Austin M. Cooper, 85 Richmond Street West, Toronto 1, has been appointed counsel to the Committee.

April 13th, 1960.

D. R. Richmond,
315 Treasury Building,
Queen's Park,
Toronto, Ontario.
Secretary.

VIII

LIST OF WITNESSES

(A) Persons Appearing at Public Hearings

1. Mr. E. R. Anderson,
   Greater New York Committee Opposed to Fluoridation,
   New York, New York.

2. Dr. G. Bates,
   General Director,
   Health League of Canada,
   Toronto, Ontario.

3. Mr. C. S. Boyle,
   Toronto, Ontario.

4. Mr. L. H. Bowen,
   Executive Secretary,
   National Fluoridation Committee,
   Health League of Canada,
   Toronto, Ontario.

5. Dr. C. A. Brusch,
   Brusch Medical Centre,
   Cambridge, Massachusetts.

6. Dr. C. Buck,
   Associate Professor,
   Department of Psychiatry and Preventive Medicine,
   The University of Western Ontario,
   London, Ontario.

7. Dr. W. Costain,
   Toronto, Ontario.

8. Mr. W. H. Coulter,
   Property Owners Association of Metropolitan Toronto,
   Toronto, Ontario.

9. Mr. W. C. Coupland,
   Toronto, Ontario.

10. Mr. J. J. Darling,
President,
Dominion Fluoridators Limited,
Toronto, Ontario.

11. Mr. A. B. Davies,
Hamilton, Ontario.

12. Mr. J. C. D. d'Esterre,
Kingston, Ontario.

13. Dr. W. J. Dunn,
Registrar-Secretary,
Royal College of Dental Surgeons,
Toronto, Ontario.

14. Dr. F. B. Exner,
Seattle, Washington.

15. Dr. R. M. Grainger,
Associate Professor in Dentistry (Epidemiology),
Faculty of Dentistry,
University of Toronto,
Toronto, Ontario.

16. Dr. M. Heit,
Chairman,
Citizen's Committee on Fluoridation,
Ottawa, Ontario.

17. Mr. I. L. Honsberger,
Toronto, Ontario.

18. Mr. W. C. Jackson,
Sudbury Citizen's Health Committee,
Sudbury, Ontario.

19. Dr. M. E. Jarrett,
Director of Dental Services,
Wellington, Halton, Wentworth County Health Units,
Fergus, Ontario.

20. Mr. J. Johnson,
Dominion Fluoridators Limited,
Toronto, Ontario.

21. Mr. J. Kieran,
Health League of Canada,
Toronto, Ontario.

22. Dr. A. A. London,
National Secretary,
The Medical-Dental Ad Hoc Committee on Evaluation of Fluoridation,
Boonton, New Jersey.

23. Mr. George MacMillan,
President,
Citizen's Health Association,
Toronto, Ontario.

24. Dr. E. W. McHenry,
Professor of Nutrition,
School of Hygiene,
University of Toronto,
Toronto, Ontario.

25. Mrs. M. Mott,
Chairman,
Kingston Pure Water Committee,
Kingston, Ontario.

26. Dr. G. Nikiforuk,
Professor of Preventive Dentistry,
Faculty of Dentistry,
University of Toronto,
Toronto, Ontario.

27. Dr. K. J. Paynter,
Professor of Dental Anatomy,
Faculty of Dentistry,
University of Toronto,
Toronto, Ontario.

28. Mr. G. E. Radcliffe,
Kingston, Ontario.

29. Mrs. F. D. Richardson,
Pure Water Committee of Ottawa,
Ottawa, Ontario.

30. Miss J. Ross,
Gravenhurst, Ontario.

31. Dr. E. A. Sellers,
Professor of Pharmacology,
Department of Pharmacology,
University of Toronto,
Toronto, Ontario.

32. Mr. H. Singh,
Toronto, Ontario.

33. Dr. A. B. Sutherland,
Director of Dental Services,
Sudbury District Health Unit,
Sudbury, Ontario.

34. Mr. D. S. Wetherhead,
Toronto, Ontario.

35. Mr. D. B. Williams,
Water Works Chemist,
Public Utilities Commission,
Brantford, Ontario.

(B) Persons Appearing at Private Hearings

1. Dr. A. E. Berry,
General Manager,
Ontario Water Resources Commission,
Toronto, Ontario.

2. Dr. H. K. Brown,
Consultant,
Dental Health Division,
Department of National Health and Welfare,
Ottawa, Ontario.

3. Dr. W. G. Cameron,
   Toronto, Ontario.

4. Dr. J. H. Johnson,
   Professor of Dental Surgery and Anaesthesia,
   Faculty of Dentistry,
   University of Toronto,
   Toronto, Ontario.

5. Dr. G. H. Josie,
   Research and Statistics Division,
   Department of National Health and Welfare,
   Ottawa, Ontario.

6. Dr. S. W. Leslie,
   Toronto, Ontario.

7. Dr. W. G. Senior,
   Chief Dental Officer,
   United Kingdom Ministry of Health,
   London, England.

8. Dr. G. L. Waldbott,
   Detroit, Michigan.

IX

GEOGRAPHICAL DISTRIBUTION OF FLUORIDES IN WATER

Partial List of Areas in which the Domestic Water Supplies Contain Appreciable Amounts of Fluorides - 0.5 p.p.m. or Higher

Country	Reference
Arabian Peninsula	Clawson et al 1940
Argentina	Chaneles 1932, Munoz 1934, Erausquin 1934a, 1934b, 1934c, 1934d, 1935a, 1935b, 1938, Trelles 1938, Pasqualini & Celli 1940, Herr & Galissier 1952.
Australia	Clements 1939
Azores	Harris 1924
Bahamas	McKay 1918
Canada	see listing, Appendix X
Cape Verde Islands	McKay 1919
China	Anderson & Stevenson 1930, Anderson 1932, Rep. Water Works Dept., Br. Municipal Council, Teintsin 1935, Wang, 1936, Cheng & Chou 1939
East Africa (Kenya)	Williamson 1951
England	Ainsworth 1933, Bowes & Murray 1936, Wilson 1939, 1941, Bromehead 1941, Murray & Wilson 1942, Bromehead et al 1943,

Country	Reference
(England, cont'd)	Suckling 1943 Weaver 1944a, 1944b, 1950 Forrest et al 1951
Ecuador	Munoz 1937, 1939
Greece	Mavogordato 1951
Greenland	Pedersen 1940
Hungary	Bodnar & Straub 1946, Adler et al 1950, 1951
Indonesia	Liang 1939
Italy	Eager 1901, Gasparrini & Piergili 1916, McKay 1928, Ricci 1933, Schour & Massler 1947, Tempestini 1949, 1952, Fiorentini & Galeazzi 1952
India	Khera 1936, Pillai 1938, Shortt et al 1937, Pandit 1939, Pandit et al 1940, Shortt et al 1937, Raghavachari & Venkataramanan 1940, Day 1940, Shourie 1946
Japan	Masaki 1931, Nakano 1933, Okuno 1941, Noguchi 1948
Malaya	Tratman 1940
Mexico	Mazzotti & Gonzalez 1939, Bermudez 1944
North Africa Tunisia Morocco Algiers	Velu 1923, 1932, 1933, 1934 Gaud et al 1934

Country	Reference
Portugal	de Carvalho 1936
South Africa	Brown 1935, Ockerse 1941a, 1941b, 1944a, 1944b, 1946, 1949, Ockerse & Meyer 1941
South Sea Islands (Toyobie Is.)	Ockumara 1934
Sweden	Fischer & Forsberg 1944, Forsberg 1944, Nordh & Seaden 1945, Maunsbach 1947
Switzerland	von Fellenberg 1948, Schmid 1948, 1950
Union of Socialist States of Russia	Gabovich 1949, 1950a, 1950b, Nikolaeva 1949, Patrikeev 1950
United States of America	McKay & Black, 1916a, 1916b, 1916c, 1916d, McKay 1918, 1925, 1928, 1948, 1952, Smith et al 1931, Smith & Smith 1932, Smith et al 1936, Smith 1935, Dean 1933, 1936, 1937, 1942, Dean et al 1935, Dean & Elvove 1935, 1936, 1937, Dean et al 1939 Dean et al 1942 Van Burkalow 1946, Hill et al 1949

X

AMOUNTS OF NATURAL FLUORIDE IN SOME MUNICIPAL WATERS IN CANADA

Place	Water Source	Fluoride Content p.p.m.
Province of British Columbia		
Bralore		0.1
Boston Bar	Stoyoma Creek	0.01
Cloverdale		1.2
Creston	Arrow Creek	0.1
Enderby		0.25
Fort Steel		0.1
Fort St. John	Charlie Lake	0.02
Kelowna	North Okanagan Lake	0.2
Kimberley (airport)	Deep Well	0.07
McBride	Dominion Creek	0.10
North Vancouver	Lynn Creek	0.05
North Kamloops	South Thompson River	0.07
Oliver	Shallow Well	0.5
Summerland	Headwaters Lake	0.2
Sidney	5 Wells and a Spring	0.25
Trail	Columbia River	0.1
Vernon	Kalamalka Lake and Mountain Springs	0.1
Williams Lake		0.1
Yale		0.03
Province of Alberta		
Beaver River		0.1
Bonnyville	Shallow Well	0.35
Cardston	From River	0.3
Lacombe	Deep Well	1.0
Mirror	Well	0.5
Saunders Lake		0.4
St. Paul		0.07

Place	Water Source	Fluoride Content
		p.p.m.
Province of Saskatchewan		
Prince Albert	North Saskatchewan River	0.12
Shaunavon	Well	0.1
Swift Current	Swift Current Creek	0.25
Weyburn	Souris River	0.18
Yorkton	3 Wells	0.2
Province of Manitoba		
Winnipeg	Shoal Lake, Lake of the Woods	0.25
Province of Ontario		
Arthur		1.4
Aylmer	Well No. 2	1.2
Blenheim		1.6
Blyth		1.6
Bothwell		1.8
Brownsville		1.0
Brussels		2.2
Caledonia	Wells (water softened)	0.60
Chesley		0.9
Clifford		1.2
Clinton	Well (a)	0.8
Clinton	Well (b)	1.0
Cobourg	Springs	0.05
Comber		1.0
Courtwright		1.8
Dresden	Well	2.0
Dunnville	Grand River	0.2
Embro		1.0
Essex	Boone Well	2.5
Etobicoke Twp.	Deep Wells	0.05
Fergus	Well	0.8
Forest		2.0
Galt	Civic Well	0.38

Place	Water Source	Fluoride Content
		p.p.m.
Georgetown	Deep Well	0.2
Glencoe		2.0
Gravenhurst	Wells	0.21
Guelph	Park Street Well	0.3
Hagersville	Deep Well	1.2
Hagersville	Well (b)	2.2
Hamilton	Lake Ontario	0.1
Harriston		0.8
Hensall		1.1
Hickson		1.3
Ingersoll	Springs	0.05
Ingersoll	Wells	1.5
Kitchener	Wells	0.05
Leamington	Wells	0.5
Lindsay	Scugog River	0.07
Listowel		1.0
London	Norton St. Well	0.7
London	(Springs) Springbank	0.1
London	Foster Wells	0.3
Lucknow	Wells	2.0
Meaford	Georgian Bay	0.1
Milverton		1.0
Mitchell		1.6
Mt. Forest		1.2
Niagara-on-the-Lake	Niagara River	0.1
North York Twp.	Well Plant No. 2	0.05
Norwich		1.0
Oakville	Lake Ontario	0.08
Orillia	Well	0.05
Oshawa	Lake Ontario	0.10
Paris	Springs	0.05
Parkhill		1.8
Peterborough	Otonabee River	0.07
Petrolia	Lake Huron	0.05
Port Colborne	Lake Erie	0.15
Port Dover	Springs	0.1
Port Credit	Lake Ontario	0.1
Port Elgin	Wells and Springs	0.2
Preston	Well No. 2	0.1

Place	Water Source	Fluoride Content
		p.p.m.
Preston	Well (b)	0.8
Ridgetown	8 Wells	1.2
Ridgetown	Well (b)	1.6
Ripley		2.4
Scarborough Twp.	Lake Ontario	0.09
Seaforth	Wells	0.8
Seaforth	Well (b)	1.2
Shelburne	Well	1.5
Simcoe	Wells and Springs	0.1
Sioux Lookout	Pelican Lake	0.05
Smithville		1.0
South Dorchester Twp.	76 Private Wells	0.7
South Dorchester Twp.	95 Private Wells	0.7 to 2.4
South River	Springs	0.1
Stamford Twp.	Wells	0.1
St. Catharines	Welland Canal	0.1
St. Mary's	Wells	1.0
St. Thomas	Kettle Creek	0.25
Stirling	Gravel and Sand Well	0.25
Stirling	Rock Well	0.15
Stratford	Wells	1.6
Tara	Well (a)	0.8
Tara	Well (b)	0.9
Tavistock	Spring	0.05
Tecumseh	Detroit River	0.1
Teeswater	Artesian Well	0.5
Thamesford		1.2
Thornbury	Beaver River	0.10
Thorold	Welland Canal	0.15
Thorold Twp.	Welland Canal	0.05
Tilbury	Lake St. Clair	0.05
Tillsonburgh	Wells (a)	0.15
Tillsonburgh	Wells (b)	1.4
Trenton	Springs and Wells	0.05
Tweed	Foster Dairy Well	0.05
Tweed	Well (b)	1.4
Uxbridge	Wells	0.04
Walkerton	Wells and Springs	1.5
Waterloo	Seagram Well	0.40

Place	Water Source	Fluoride Content
		p.p.m.
Wingham		1.1
West	Lake Erie	0.4
Woodstock	Gravel Wells	0.15
Zurich		2.2

Source: Department of National Health and Welfare, Ottawa, Canada (1953).

XI

FLUORINE CONTENT OF FOODS

Food	Fluorine, parts per million	Food	Fluorine parts per million
Fluorine reported in food as consumed			
Milk	0.07-0.22	Pork chop	1.00
Egg white	0.00-0.60	Frankfurters	1.70
Egg yolk	0.40-2.00	Round steak	1.30
Butter	1.50	Oysters	1.50
Cheese	1.60	Herring (smoked)	3.50
Beef	0.20	Canned shrimp	4.40
Liver	1.50-1.60	Canned sardines	7.30-12.50
Veal	0.20	Canned salmon	8.50- 9.00
Mutton	0.20	Fresh fish	1.60- 7.00
Chicken	1.40	Canned mackerel	26.89
Pork	0.20		
Fluorine reported in dry substance of food			
Rice	1.00	Honey	1.00
Corn	1.00	Cocoa	0.50-2.00
Corn (canned)	0.20	Milk chocolate	0.50-2.00
Oats	1.30	Chocolate (plain)	0.50
Crushed oats	0.20	Tea (various brands*)	30.00-60.00
Dried beans	0.20	Cabbage	0.31-0.50
Whole buckwheat	1.70	Lettuce	0.60-0.80
Wheat bran	1.00	Spinach	1.00
Whole wheat flour	1.30	Tomatoes	0.60-0.90
Biscuit flour	0.00	Turnips	0.20
Flour	1.10-1.20	Carrots	0.20
White flour	1.00	Potato (white)	0.20
Ginger biscuit	2.00	Potato (sweet)	0.20
Rye bread	5.30	Apples	0.80
Gelatin	0.00	Pineapple (canned)	0.00
Dextrose	0.50	Orange	0.22

* Analysis of tea leaf. A cup of tea contains about 0.12 mg. of fluorine.

Source: McClure, F. J., National Inst. of Health Bulletin, 172, 1939.

XII

CIVIL RIGHTS AND FLUORIDATION IN THE UNITED STATES

The United States Constitution as originally adopted did not contain the provisions which are known as "The Bill of Rights". These were later added as amendments to the Constitution. The provisions pertinent to the "fluoridation" cases are as follows:
First Amendment: Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the Government for a redress of grievances.

Fifth Amendment: No person shall be held to answer for a capital, or otherwise infamous crime, unless on a presentment or indictment of a Grand Jury, except in cases arising in the land or naval forces, or in the militia, when in actual service in time of war or public danger; nor shall any person be subject for the same offence to be twice put in jeopardy of life or limb; nor shall be compelled in any criminal case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation.

Fourteenth Amendment: Section I. All persons born or naturalized in the United States, and subject to the jurisdiction thereof, are citizens of the United States and of the State wherein they reside. No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States, nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws.

A California District Court of Appeal in De Aryan v. Butler (1953) 260 P. 2d 98, held that the addition of fluoride to the water supply of San Diego was a valid exercise of the city police power and was not an invasion of the constitution reserving to the

people immunity of the person and independent right to life and liberty. The same result based upon the same reasoning was reached by the Supreme Courts of Oklahoma in Dowell v. City of Tulsa (1954) 273 P. 2d 859 and of Louisiana in Chapman v. City of Shreveport (1954) 74 So 2d 142.

In addition to holding that fluoridation of municipal water supplies was not a denial of the citizens' constitutional rights guaranteed by the Fourteenth Amendment, the Supreme Courts of Washington in Kaul v. City of Chehalis (1954) 277 Pac. 2d 352 and of Ohio in Kraus v. City of Cleveland (1955) 127 NE 2d 609, decided that fluoridation by a city of its water supply did not constitute engaging in the selling of drugs or practising medicine, dentistry or pharmacy. The contention that fluoridation infringed the free exercise of religion was not accepted by the Supreme Court of Oregon in Baer v. City of Bend (1956) 292 Pac 2d 134.

The Supreme Court of the United States refused to review the decisions of the State Courts in De Aryan v. Butler (347 U.S. 1012), Dowell v. City of Tulsa (75 S.C.R. 292), Chapman v. City of Shreveport (348 U.S. 89) and Kraus v. City of Cleveland (351 U.S. 934).

These American cases decide that the personal rights guaranteed by the Bill of Rights are not absolute but are qualified by reasonable exercise of the state police power to secure better health for the nation's citizens. There is no reason to believe that the result would be any different in Ontario even if the Legislature's powers were subject to a bill of rights in the same terms as Canadian Bill of Rights, Statutes of Canada, 1960, c. 44.

XIII

MATERIAL PREPARED FOR THE COMMITTEE

1. Grainger, R.M., Nikiforuk, G., and Paynter, K.J., Dental Health and Fluorides, a Report to the Ontario Fluoridation Investigating Committee, November, 1959.

2. Sellers, E.A., and Marton, A.V., The Pharmacological, Physiological and Pathological Effects of Fluorides on the Mammalian Body, a Report to the Ontario Fluoridation Investigating Committee, November 1959.

3. Buck, C., A Review of Epidemiological and Statistical Evidence Concerning the Possible Harmful Effects of Water-Borne Fluoride upon Non-Dental Organs and Processes, a Report to the Ontario Fluoridation Investigating Committee, September, 1959.

4. McHenry, E. W., Nutrition Aspects of Fluorine and other Trace Elements, a Report to the Ontario Fluoridation Investigating Committee, November, 1959.

5. McHenry, E.W., Study of the Relationship of Food Intakes to the Anti-Cariogonic Effect of Fluorine, a Report to the Ontario Fluoridation Investigating Committee, 1960.

6. Buck, C., and Sellers, A. H., Mortality in Ontario Municipalities in Relation to the Fluoride Content of the Water Supply, a Report to the Ontario Fluoridation Investigating Committee, 1960.

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